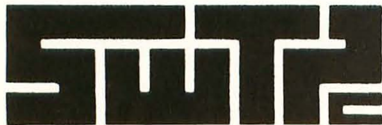
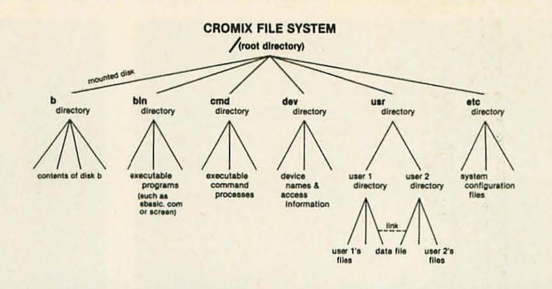

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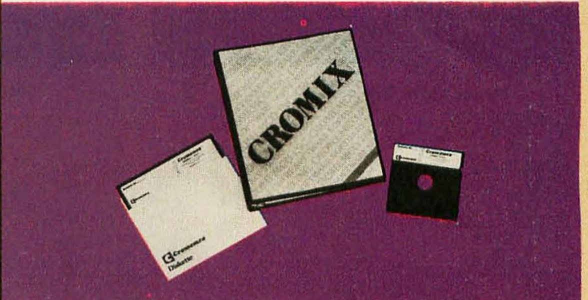


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And now we've come up with the industry's first UNIX-lookalike for microcomputers. It's a tried and proven operating system. It's available on both 5" and 8" diskettes for Cromemco systems with 128K or more of memory.

Here are just some of the features you get in this powerful Cromemco system:

- Multi-user and multi-tasking capability
- Hierarchical directories
- Completely compatible file, device, and interprocess I/O
- Extensive subsystem support

FILE SYSTEM

One of the important features of our CROMIX is its file system comprised of hierarchical directories. It's a tree structure of three types of files: data files, directories, and device files. File, device, and interprocess I/O are compatible among these file types (input and output may be redirected interchangeably from and to any source or destination).

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TREMENDOUS ADDRESS SPACE, FAST ACCESS

The flexible file system and generalized disk structure of CROMIX give a disk address space in excess of one gigabyte per volume — file size is limited only by available disk capacity.

Speed of access to disk files has also been optimized. Average access speeds far surpass any yet implemented on microcomputers.

'C' COMPILER AVAILABLE, TOO

Cromemco offers a wide range of languages that operate under CROMIX. These include a high-level command process language and extensive subsystem support such as COBOL, FORTRAN IV, RATFOR, LISP, and 32K and 16K BASICs.

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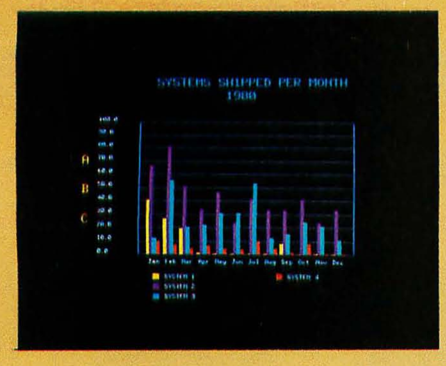
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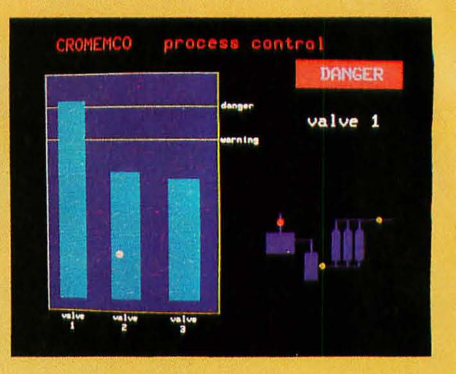


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Basically, this new Cromemco Model SDI* is a two-board interface that plugs into any Cromemco computer.

The SDI then maps computer display memory content onto a convenient color monitor to give high-quality, high-resolution displays (756 H x 482 V pixels).

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The resolution surpasses that of a color TV picture.

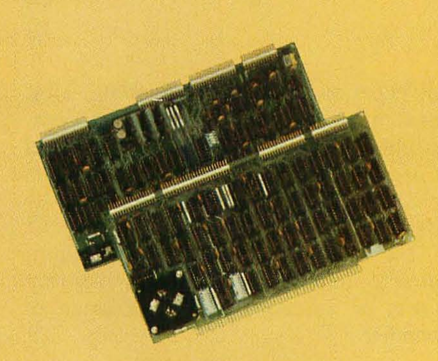
BASIC/FORTRAN programming

Besides its high resolution and low price, the new SDI lets you control with optional Cromemco software packages that use simple BASIC- and FORTRAN-like commands.

Pick any of 16 colors (from a 4096-color palette) with instructions like DEFCLR (c, R, G, B). Or obtain a circle of specified size, location, and color with XCIRC (x, y, r, c).

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Model SDI High-Resolution Color Graphics Interface

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Model SDI plugs into Z-2H 11-megabyte hard disk computer or any Cromemco computer

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The SDI has still more features that you should be informed about. So contact your Cromemco representative now and see all that the SDI will do for you.



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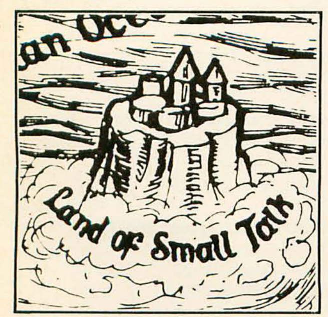
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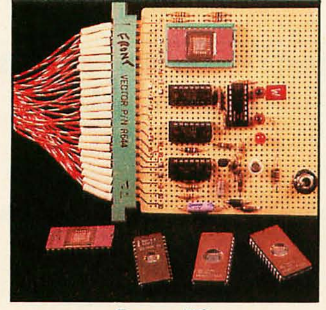
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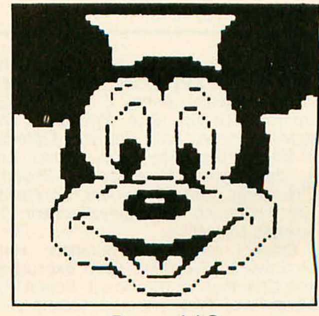
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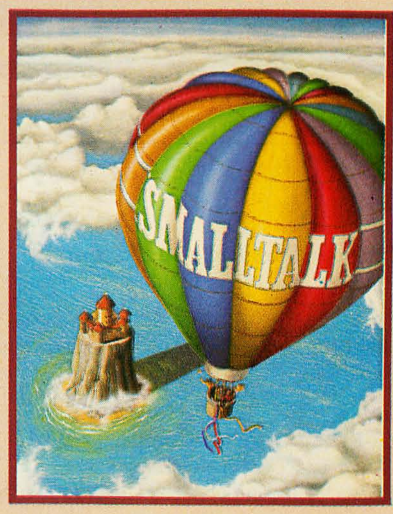
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In This Issue

Smalltalk isn't small talk any more. Three years ago, the cover of BYTE depicted the island kingdom of Smalltalk as a place where great and magical things happen, though its "craggy aloofness" kept it out of the mainstream of the computer programming community. During the past three years the Xerox Learning Research Group has continued developing Smalltalk, and this month we present the culmination of its work — the debut of the Smalltalk-80 system.

Because of the special nature of this issue, we have added a special introduction by Adele Goldberg, manager of the Xerox Learning Research Group based in Palo Alto, California. Adele guides you gently through the array of articles describing the Smalltalk-80 system and related topics.

In addition to our regular features, we also have the concluding part of Steve Ciarcia's article, "Build a Z8-Based Control Computer with BASIC." And Stan Miastkowski presents an in-depth report on what we can expect from Japan in his article, "The Japanese Computer Invasion."

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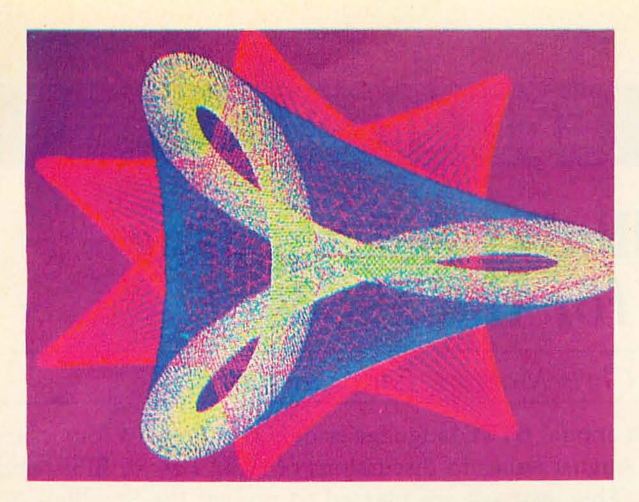
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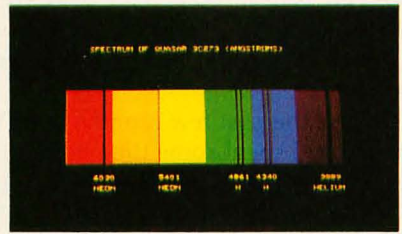
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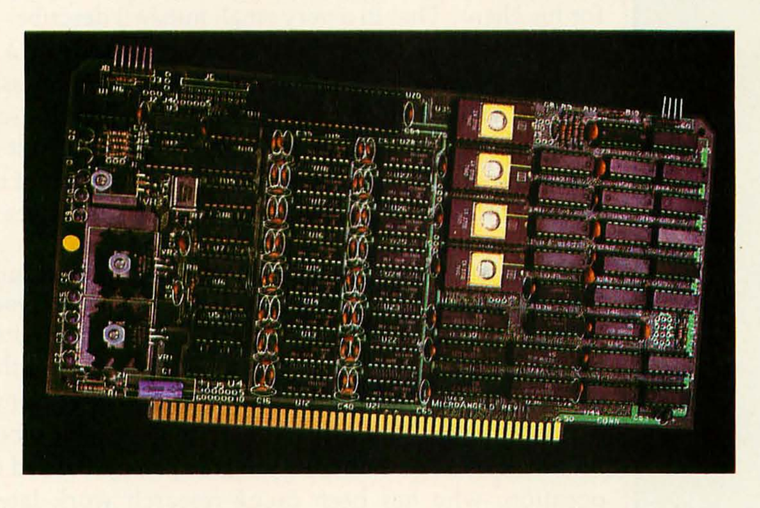
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Editorial

Smalltalk: A Language for the 1980s

by Chris Morgan, Editor in Chief

Welcome to the fifth annual BYTE language issue. Over the past four years we have devoted our August issues to discussions of APL, Pascal, LISP, and FORTH, respectively. This year we are pleased to present the Smalltalk-80 language, the culmination of ten years of research by the Xerox Learning Research Group located at the Xerox Palo Alto Research Center (PARC) in California.

During the past few months the BYTE staff has been acquainting itself with Smalltalk. I spent some time this spring working with the Smalltalk systems at Xerox PARC and being briefed by Adele Goldberg and Dave Robson. I came away excited by this revolutionary language. I hope the articles in this issue convey some of that excitement.

Smalltalk is an *object-oriented* language, as opposed to *procedure-oriented* languages such as BASIC, Pascal, and FORTRAN. Because of this, programming in Smalltalk is similar to the process of human interaction. An analogy might help to clarify this point. Suppose a person wishes to invest in a good mutual fund. He sends a telegram to his broker. The broker analyzes the current state of the market and picks what he considers to be the best mutual fund for his client. That in a very small nutshell describes the basic activity inherent in all Smalltalk programs: a message is sent to a receiver to invoke some response. In our analogy, the telegram is the message and the broker is the receiver. The telegram has two parts, called the *selector* and the *argument*. Here the selector is "buy" and the argument is "best mutual fund." The broker belongs to a *class* which contains the description of the *method* he uses to pick the best mutual fund. Because of this, the client does not have to tell the broker how to do his job.

Of course, my analogy skims only the thinnest surface of the deep waters of the Smalltalk-80 system, as you'll see when you read the articles in this issue.

When I first worked at a Smalltalk-80 computer terminal, I noticed an interesting phenomenon: I did very little typing, although a full keyboard was available to me. This is because of the window menu format and the presence of the "mouse," a small mechanical box with wheels that lets you quickly move the cursor around the screen. (Stoney Ballard of Digital Equipment Corporation, who has been doing research work lately with the Smalltalk-80 system, points out that he was able to do a significant amount of programming with his experimental system over several weeks even though his keyboard was not working.) Choosing a particular item in a list from a window causes another window to appear on the screen. Additional levels of nested windows can be accessed by continuing to reposition the cursor and pressing the appropriate key on the mouse.

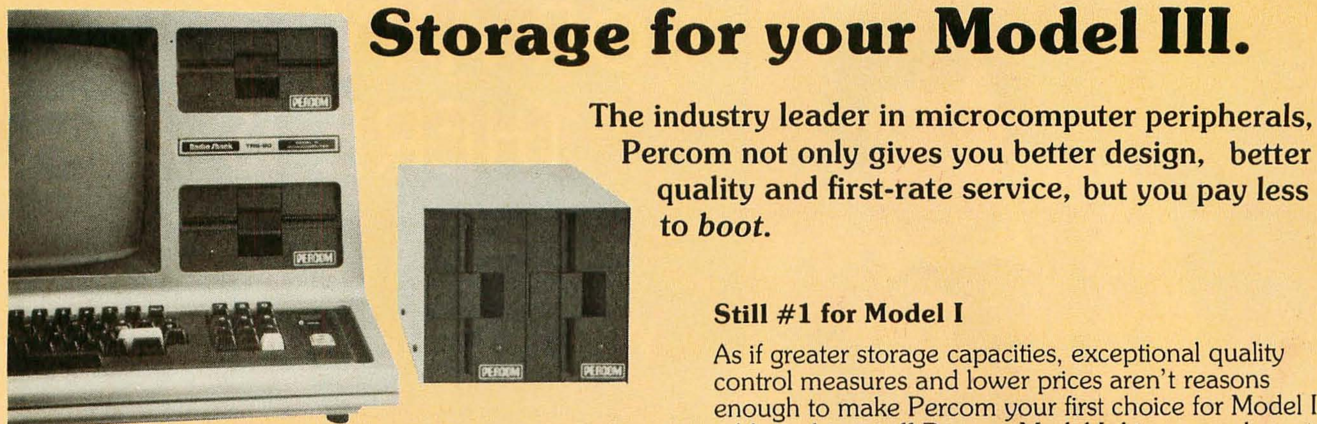
This makes for *fast* programming. Those who saw the remarkable demonstration of the Xerox Star terminal (Xerox's new $16,000 office terminal) at the National Computer Conference (NCC) this past spring got a taste of what a programming environment can do for productivity.

Smalltalk allows the user to solve more problems without becoming a computer expert. Larry Tesler from Apple (who wrote "The Smalltalk Environ-

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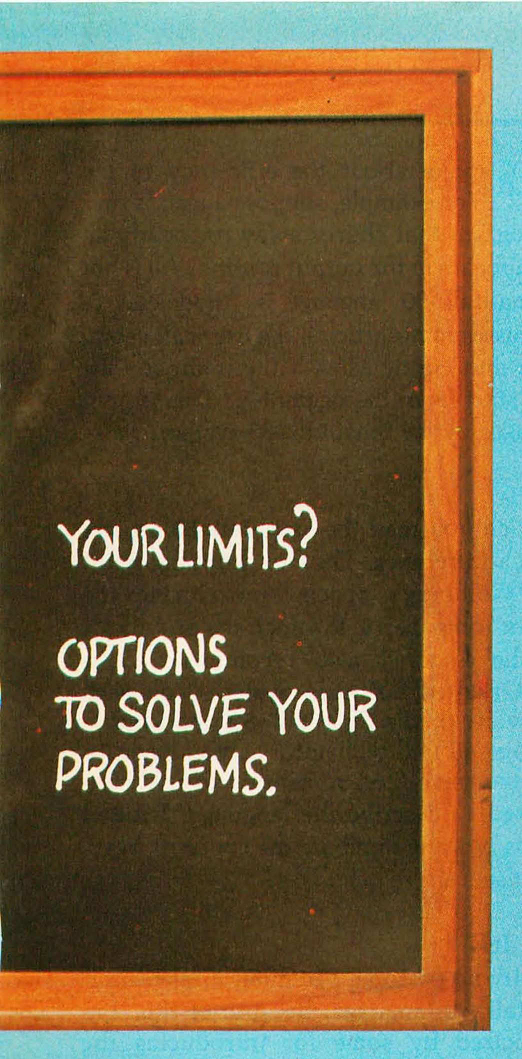
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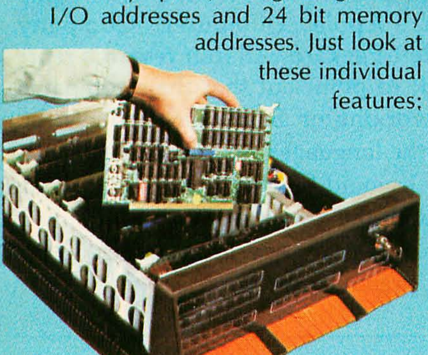
*In Calculus, a fundamental statement in the definition of limit; interpreted here to imply: "For your integration problem, Intersystems has a solution."

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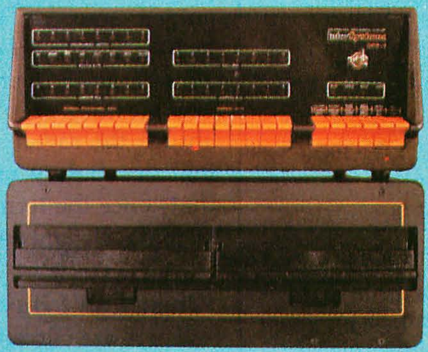
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- MPU-8000 — available with the non-segmented Z-8002[†], which directly addresses 64K, or the segmented Z-8001[†], which can directly address 8 Megabytes.

Extended systems options...



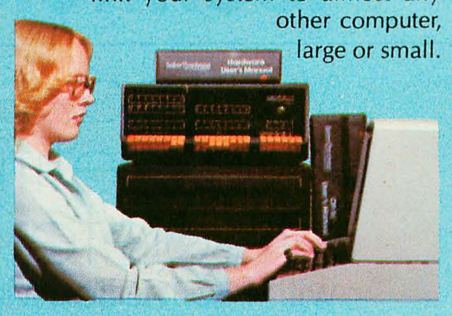
Interfacing disk drives is not a trivial matter, so when your objectives and resources dictate you spend your energy elsewhere, use our resources to perform the service for you. We can add our disk drive package to any Z-80 or Z-8000 configuration we provide ... again, fully assembled and tested and covered under one warranty.

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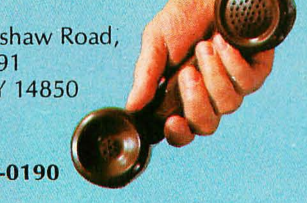
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ment" on page 90) spoke about the efficiency of the language at the NCC. For example, suppose a user is running a complex program that churns away for nearly an hour—then a bug appears in the output routine. All is not lost. Since the Smalltalk-80 language is "modeless" (a concept Tesler discusses in his article), the user can debug the output routine and continue with the main routine without having to start from the beginning. This is only one of the advantages of the Smalltalk-80 system.

Where to Start

The order in which you read the Smalltalk-80 articles in this issue makes a difference. The first stopping point should be Adele Goldberg's article "Introducing the Smalltalk-80 System" on page 14, in which she provides a guided tour of the issue. I also recommend Dave Robson's "Object-Oriented Software Systems" on page 74 as a good overview of the Smalltalk-80 philosophy. The glossary on page 48 will be helpful as you begin to absorb the rather extensive (and sometimes overwhelming) vocabulary used to describe the language. I found that, once the terms become familiar, the concepts begin to make elegant sense.

When Can I Buy It?

There are currently no personal computer implementations of the Smalltalk-80 language. Because of this, I'm sure we'll be criticized by some for introducing the language too early and frustrating our readers. Nevertheless, I feel that the time to begin exposing people to object-oriented language is *now*. Only by challenging and enticing the personal computer community can we stimulate the industry to create the machines we all dream of.

As far as future hardware hopes are concerned, it is interesting to note that four of the speakers at the recent NCC Smalltalk-80 symposium were from Digital Equipment Corporation, Apple Computer Company, Tektronix, and Hewlett-Packard. All four research representatives were quick to point out that their companies are not necessarily working on Smalltalk products, but are rather exploring the language's potential. Despite the disclaimers, though, I would be very surprised if we do not see a computer with the Smalltalk-80 system built in sometime in the next few years—perhaps sooner. I hope this issue brings that dream closer.■

Acknowledgments

I wish to express my appreciation to Adele Goldberg and Dave Robson at Xerox PARC for their invaluable help in preparing this special issue—and especially to Adele for coordinating the many authors who contributed their expertise. I'd also like to thank Gregg Williams for his editorial skills in preparing this issue . . . . CM

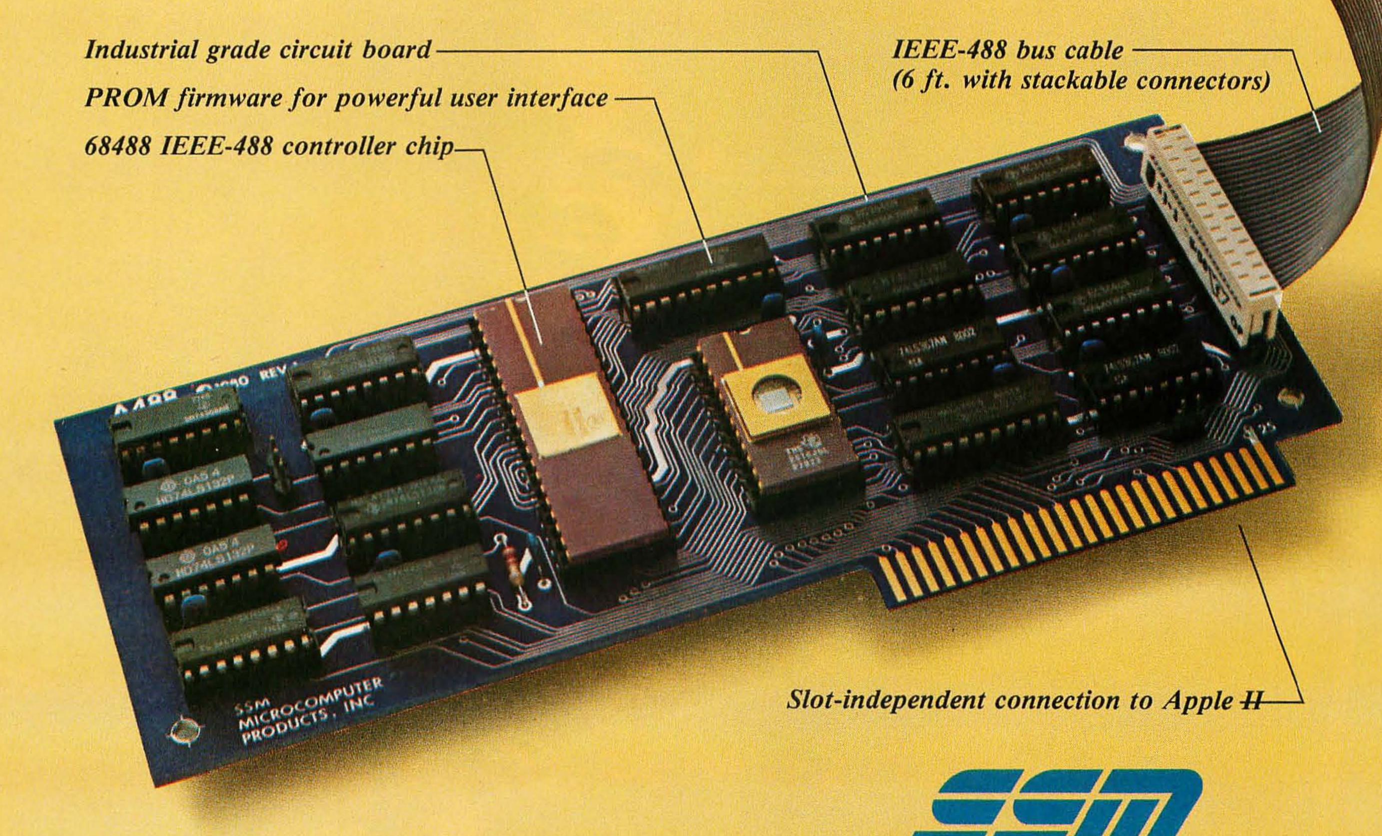
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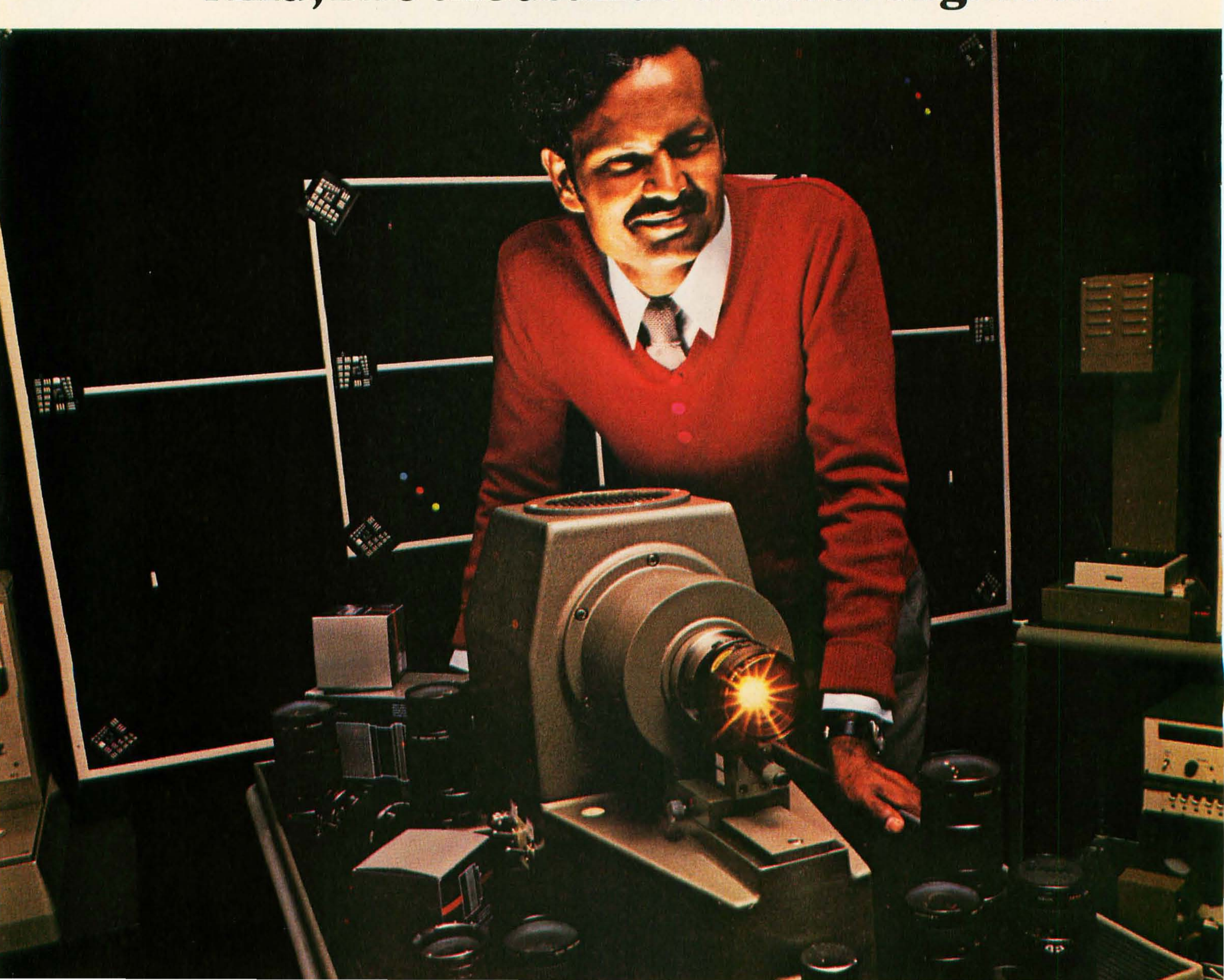
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Reddy Chirra improves his vision with an Apple.

Reddy is an optical engineer who's used to working for big companies and using big mainframes.

But when he started his own consulting business, he soon learned how costly mainframe time can be. So he bought himself a 48K Apple II Personal Computer.

And, like thousands of other engineers



and scientists, quickly learned the pleasures of cutting down on shared time and having his own tamper-proof data base.

His Apple can handle formulas with up to 80 variables and test parameters on 250 different optical glasses.

He can even use BASIC, FORTRAN, Pascal and Assembly languages.

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Introducing the Smalltalk-80 System

Adele Goldberg
Manager, Learning Research Group
Xerox Palo Alto Research Center
3333 Coyote Hill Rd
Palo Alto CA 94304

It is rare when one can indulge in one's prejudices with relative impunity, poking a bit of good humored fun to make a point.

With this statement, Carl Helmers opened his remarks in the "About the Cover" section of the August 1978 issue of BYTE. The issue was a special on the language Pascal, so Helmers took the opportunity to present Pascal's triangle as drawn by artist Robert Tinney. The primary allegory of the cover was the inversion of the Bermuda Triangle myth to show smooth waters within the area labeled "Pascal's Triangle." In explaining the allegory, Helmers guided the traveler through the FORTRAN Ocean, the BASIC Sea, around the Isle of BAL, and up to the Land of Smalltalk.

Traveling upward (in the picture) through heavy seas we come to the pinnacle, a snow white island rising like an ivory tower out of the surrounding shark infested waters. Here we find the fantastic kingdom of Smalltalk, where great and magical things happen. But alas . . . the craggy aloofness of the kingdom of Smalltalk keeps it out of the mainstream of things.

It is rare when one can indulge in one's fantasies to respond to so pointed a remark as that provided by the then editor of BYTE. This month's cover design presents just such an opportunity. It depicts the clouds clearing from around the kingdom of Smalltalk, and, with banners streaming, the Smalltalk system is taking flight into the mainstream of the computer programming community. This cover was also executed by Robert Tinney, to the delight of the Learning Research Group (LRG) of the Xerox Palo Alto Research Center. LRG is the group that has designed, implemented, and evaluated several generations of Smalltalk over the past ten years.

The balloon on the cover symbolizes the Smalltalk-80 system that is being released this year for more general access. The release is in the form of publications and a file containing the Smalltalk-80 programming system. Twelve articles describing the system appear in this issue of BYTE. Through such publication, LRG's research will become generally accessible, dispelling the clouds.

Smalltalk is the name LRG assigned to the software

TRS-80* COMPUTING EDITION

©1981 Percom Data Co., Inc. The Percom Peripheral 35 cents

Percom's DOUBLER II™ tolerates wide variations in media, drives

GARLAND, TEXAS — May 22, 1981 — Harold Mauch, president of Percom Data Company, announced here today that an improved version of the Company's innovative DOUBLER™ adapter, a double-density plug-in module for TRS-80* Model I computers, is now available.

Reflecting design refinements based on both theoretical analyses and field testing, the DOUBLER II™, so named, permits even greater tolerance in variations among media and drives than the previous design.

Like the original DOUBLER, the DOUBLER II plugs into the drive controller IC socket of a TRS-80 Model I Expansion Interface and permits a user to run either single- or double-density diskettes on a Model I.

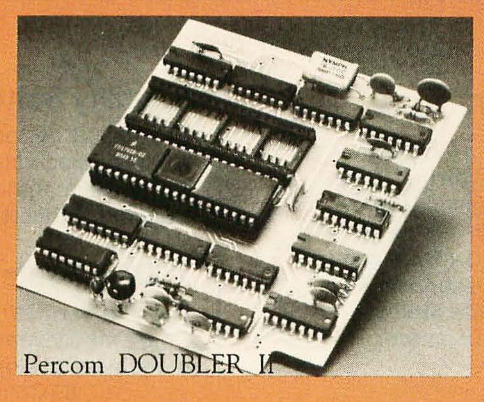
With a DOUBLER II installed, over four times more formatted data — as much as 364 Kbytes — can be stored on one side of a five-inch diskette than can be stored using a standard Tandy Model I drive system.

Moreover, a DOUBLER II equips a Model I with the hardware required to run Model III diskettes.

(*Ed. Note:* See "OS-80™: Bridging the TRS-80* software compatibility gap" elsewhere on this page.)

The critical clock-data separation circuitry of the DOUBLER II is a proprietary design called a ROM-programmed digital phase-lock loop data separator.

According to Mauch, this design is more tolerant of differences from diskette to diskette and drive to drive, and also provides immunity to performance degradation caused by circuit component aging.



Percom DOUBLER II

Mauch said "A DOUBLER II will operate just as reliably two years after it is installed as it will two days after installation."

The digital phase-lock loop also eliminates the need for trimmer adjustments typical of analog phase-lock loop circuits.

"You plug in a Percom DOUBLER II and then forget it," he said.

The DOUBLER II also features a refined Write Precompensation circuit that more effectively minimizes the phenomena of bit- and peak-shifting, a reliability-impairing characteristic of magnetic data recording.

The DOUBLER II, which is fully software compatible with the previous DOUBLER, is supplied with DBLDOS™, a TRSDOS*-compatible disk operating system.

The DOUBLER II sells for $219.95, including the DBLDOS diskette. NOW $169.95!

Owners of original DOUBLERs may purchase a DOUBLER II upgrade kit, without the disk controller IC, for $30.00. Proof of purchase of an original DOUBLER is required, and each DOUBLER owner may purchase only one DOUBLER II at the $30.00 price.

The Percom DOUBLER II is available from authorized Percom retailers, or may be ordered direct from the factory. The factory toll-free order number is 1-800-527-1592.

Ed. note: Opening the TRS-80 Expansion Interface may void the Tandy limited 90-day warranty. Circle 306 on inquiry card.

Circuit misapplication causes diskette read, format problems.
High resolution key to reliable data separation

GARLAND, TEXAS — The Percom SEPARATOR™ does very well for the Radio Shack TRS-80* Model I computer what the Tandy disk controller does poorly at best: *reliably* separates clock and data signals during disk-read operations.

Unreliable data-clock separation causes format verification failures and repeated read retries.

CRC ERROR–TRACK LOCKED OUT

The problem is most severe on high-number (high-density) inner file tracks.

As reported earlier, the clock-data separation problem was traced by Percom to misapplication of the internal separator of the 1771 drive controller IC used in the Model I.

The Percom Separator substitutes a *high-resolution* digital data separator circuit, one which operates at 16 megahertz, for the low-resolution one-megahertz circuit of the Tandy design.

Separator circuits that operate at lower frequencies — for example, two- or four-megahertz — were found by Percom to provide only marginally improved performance over the original Tandy circuit.

The Percom solution is a simple adapter that plugs into the drive controller of the Expansion Interface (EI).

Not a kit — some vendors supply an untested separator kit of resistors, ICs and other paraphernalia that may be installed by modifying the computer — the Percom SEPARATOR is a fully assembled, fully tested plug-in module.

Installation involves merely plugging the SEPARATOR into the Model I EI disk controller chip socket, and plugging the controller chip into a socket on the SEPARATOR.

The SEPARATOR, which sells for only $29.95, may be purchased from authorized Percom retailers or ordered directly from the factory. The factory toll-free order number is 1-800-527-1592.

Ed. note: Opening the TRS-80 Expansion Interface may void the Tandy limited 90-day warranty. Circle 307 on inquiry card.

All that glitters is not gold
OS-80™ Bridging the TRS-80* software compatibility gap

Compatibility between TRS-80* Model I diskettes and the new Model III is about as genuine as a gold-plated lead Krugerrand.

True, Model I TRSDOS* diskettes can be *read* on a *Model* III. But first they must be converted and re-recorded for Model III operation.

And you *cannot write* to a Model I TRSDOS* diskette. Not with a Model III. You cannot add a file. Delete a file. Or in any way modify a Model I TRSDOS diskette with a Model III computer.

Furthermore, your converted TRSDOS diskettes cannot be converted *back* for Model I operation.

TRSDOS is a one-way street. And there's no retreating. A point to consider before switching the company's payroll to your new Model III.

Real software compatibility should allow the *direct, immediate* interchangeability of Model I and Model III diskettes. No read-only limitations, no conversion/re-recording steps and no chance to be left high and dry with Model III diskettes that can't be run on a Model I.

What's the answer? The answer is Percom's OS-80™ family of TRS-80 disk operating systems.

OS-80 programs allow *direct, immediate* interchangeability of Model I and Model III diskettes.

You can run Model I single-density diskettes on a Model III; install Percom's plug-in DOUBLER™ adapter in your Model I, and you can run double-density Model III diskettes on a Model I.

There's no conversion, no re-recording.

Slip an OS-80 diskette out of your Model I and insert it directly in a Model III.

And vice-versa.

Just have the correct OS-80 disk operating system — OS-80, OS-80D or OS-80/III — in each computer.

Moreover, with OS-80 systems, you can add, delete, and update files. You can read *and write* diskettes regardless of the system of origin.

OS-80 is the original Percom TRS-80 DOS for BASIC programmers.

Even OS-80 utilities are written in BASIC.

OS-80 is the Percom system about which a user wrote, in Creative Computing magazine, ". . . the best $30.00 you will ever spend."†

Requiring only seven Kbytes of memory, OS-80 disk operating systems reside completely in RAM. There's no need to dedicate a drive exclusively for a system diskette.

And, unlike TRSDOS, you *can* work at the track sector level, defining and controlling data formats — in BASIC — to create simple or complex data structures that execute more quickly than TRSDOS files.

The Percom OS-80 DOS supports single-density operation of the Model I computer — price is $29.95; the OS-80D supports double-density operation of Model I computers equipped with a DOUBLER or DOUBLER II; and, OS-80/III — for the Model III of course — supports both single- and double-density operation. OS-80D and OS-80/III each sell for $49.95.

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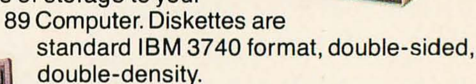
HDOS, Heath Disk Operating System gives you a sophisticated, flexible environment for program construction, storage and editing.

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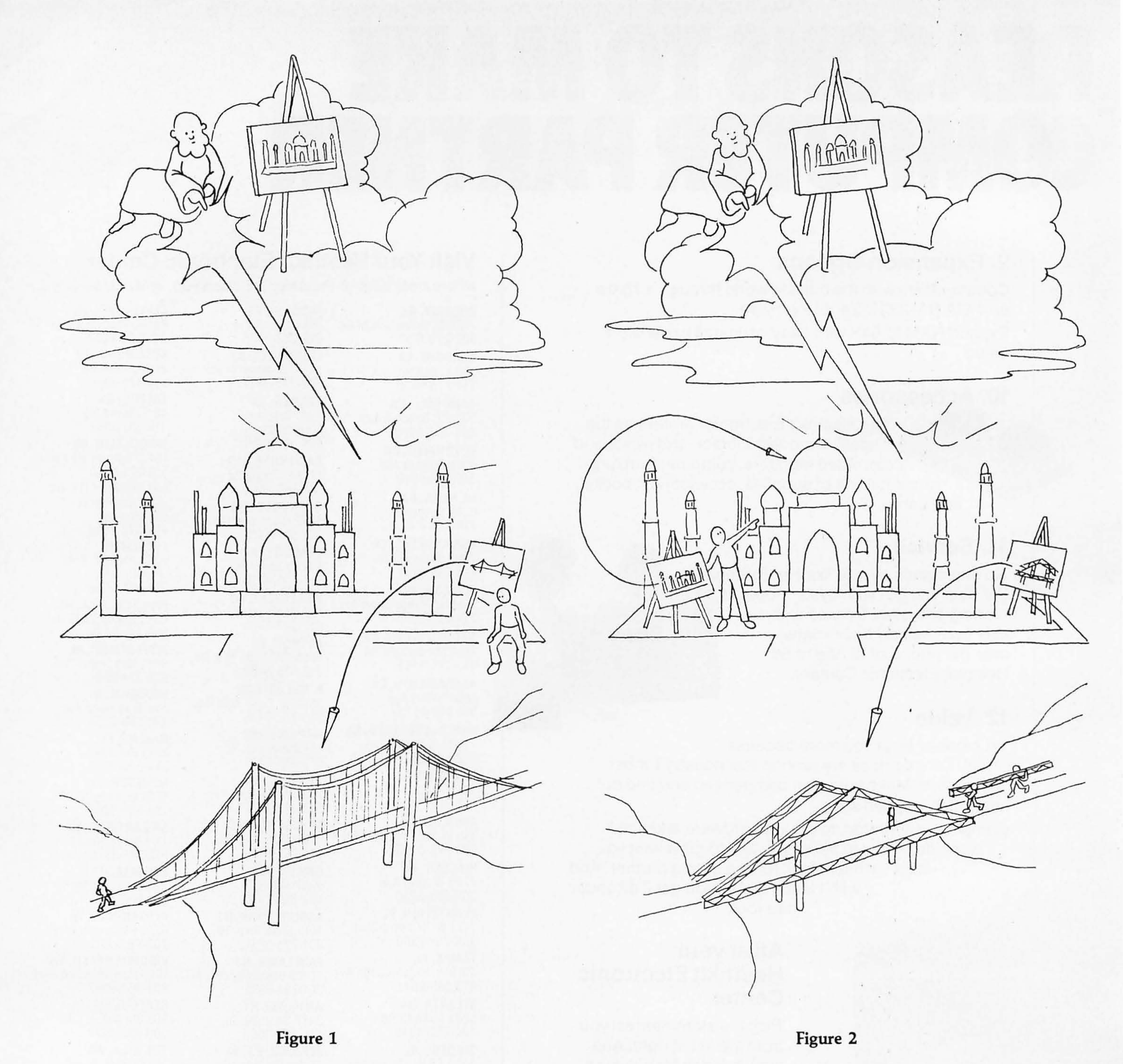


Figure 1 **Figure 2**

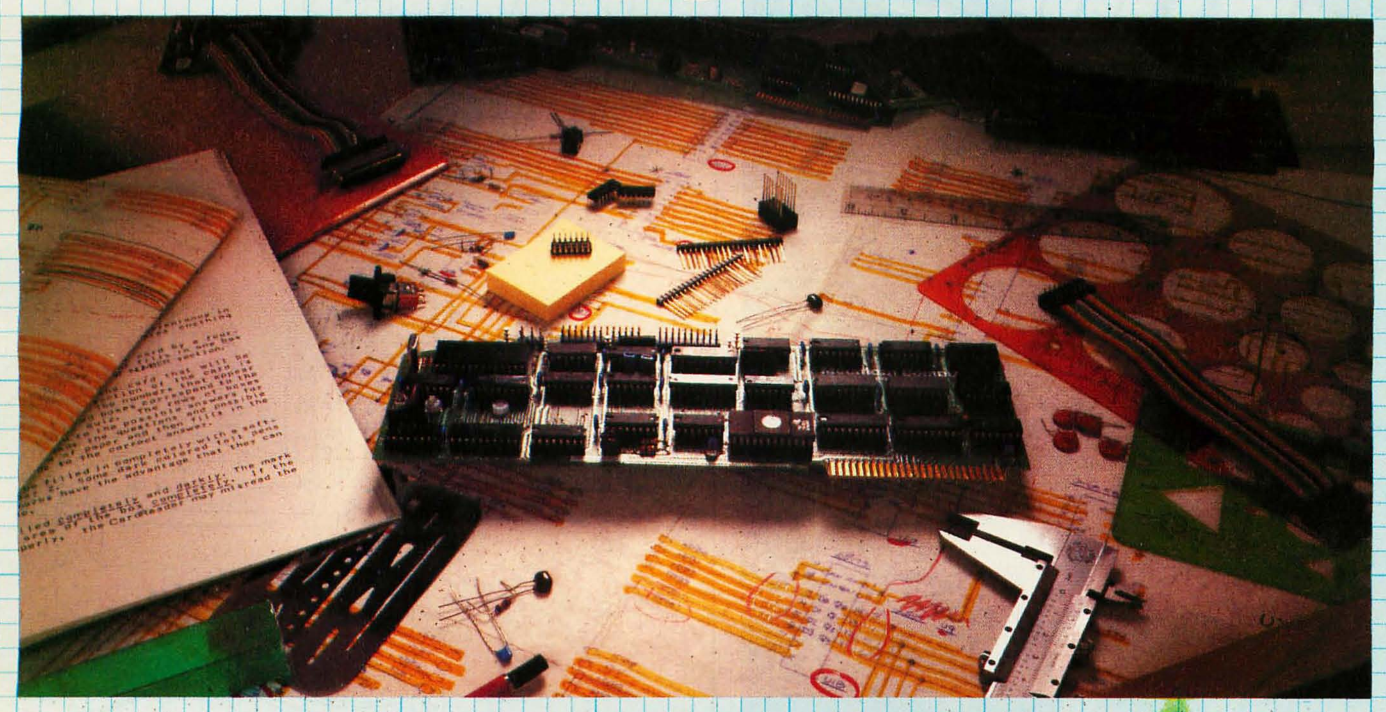
part of Alan Kay's personal computing vision, the Dynabook. The vision is a hand-held, high-performance computer with a high-resolution display, input and output devices supporting visual and audio communication paths, and network connections to shared information resources. LRG's goal is to support an individual's ability to use the Dynabook creatively. This requires an understanding of the interactions among language, knowledge, and communication. To this end, LRG does research on the design and implementation of programming languages, programming systems, data bases, virtual memories, and user interfaces.

The ivory tower on the island of Smalltalk is an exciting, creative place in which to work on these ideas. A sense of LRG's long-range goals is aptly portrayed in the illustrations designed by Ted Kaehler.

In figure 1, we see a view of the conventional software development environment: a wizard sitting on his own computational cloud creating his notion of a Taj Mahal in which programmers can indulge in building applications for nonprogramming users. The Taj Mahal represents a complete programming environment, which includes the tools for developing programs as well as the language in which the programs are written. The users must walk whatever bridge the programmer builds.

A goal in the design of the Smalltalk system was to create the Taj Mahal so that programmers can modify it by building *application kits*, which are specialized exten-

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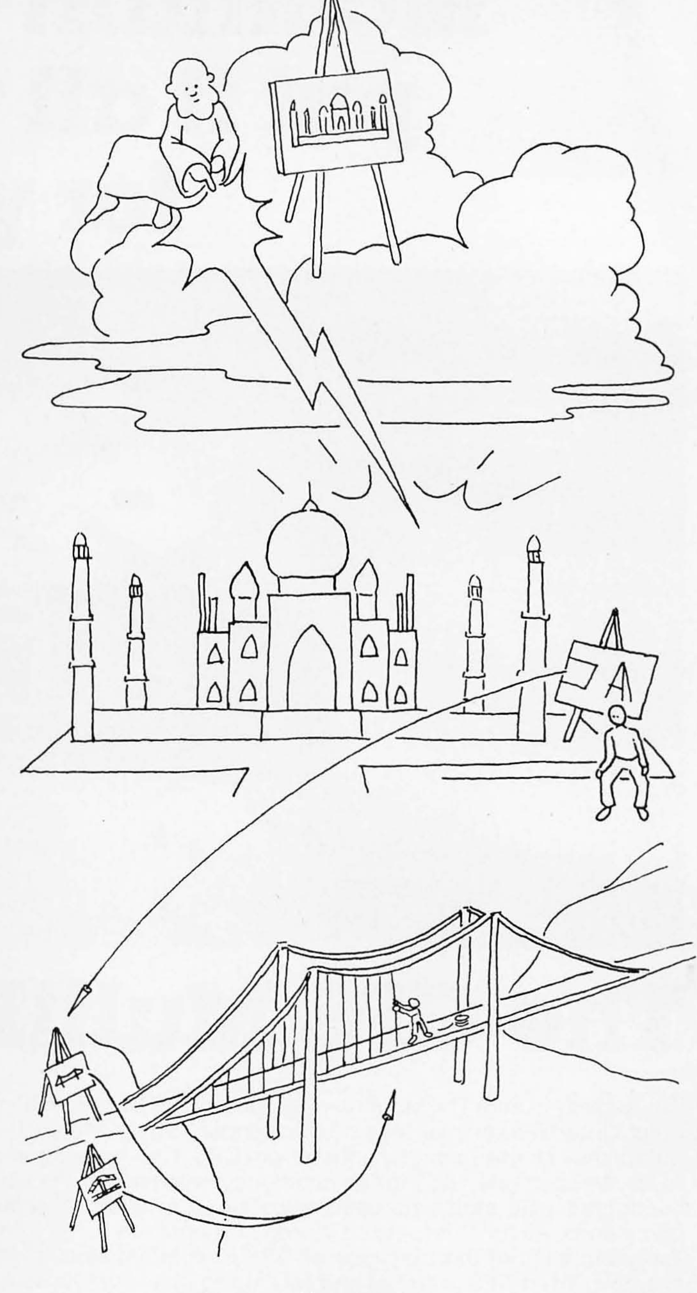


Figure 3

sions and/or subsets of the system whose parts can be used by a nonprogrammer to build a customized version of the application. Applications that can be created from a kit are related in a fundamental way: the programmer may, for example, create it for building bridges, but it is the user who pieces together the parts to create a customized bridge (see figure 2).

One of LRG's current research goals is to provide system parts to aid the programmer in creating kits. Although Smalltalk itself is conceptually sufficient for this task, it needs better support to help the programmer piece together the graphical display and the control for an interactive user interface. This is the "kit maker," as shown in figure 3.

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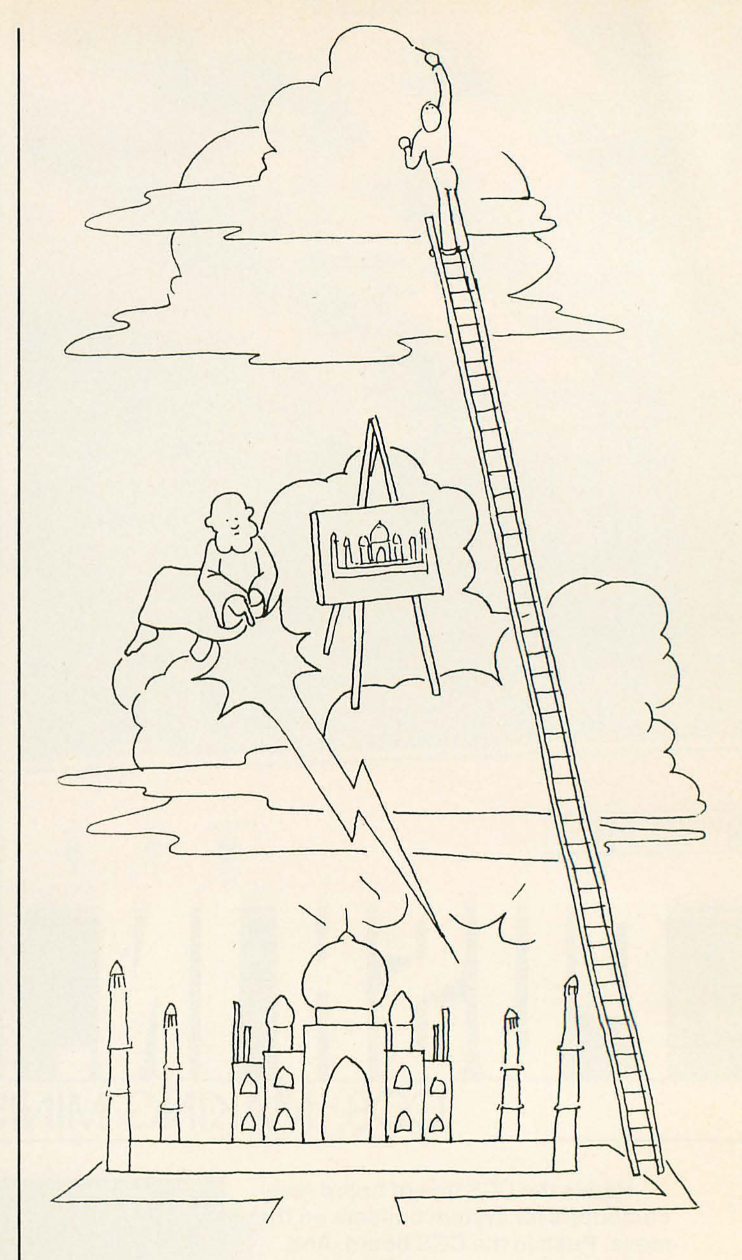


Figure 4

As part of the Dynabook vision, the system should help the programmer build a personal computational cloud (see figure 4). Two research projects, ThingLab by Alan Borning and PIE by Ira Goldstein and Danny Bobrow, took advantage of Smalltalk's support for creating new metaphors.

We are often asked: "What makes Smalltalk different from other languages?" The articles in this issue attempt to answer that question. Look for an emphasis on interactive graphics, on modular development of programs, and on integrated approaches to accessing program development tools. Also, look for the distinction between a programming language and a programming system, and consider the difference in providing a system in which the user can feel individual mastery over complexity. Although each article can be read independently of the

Text continued on page 26

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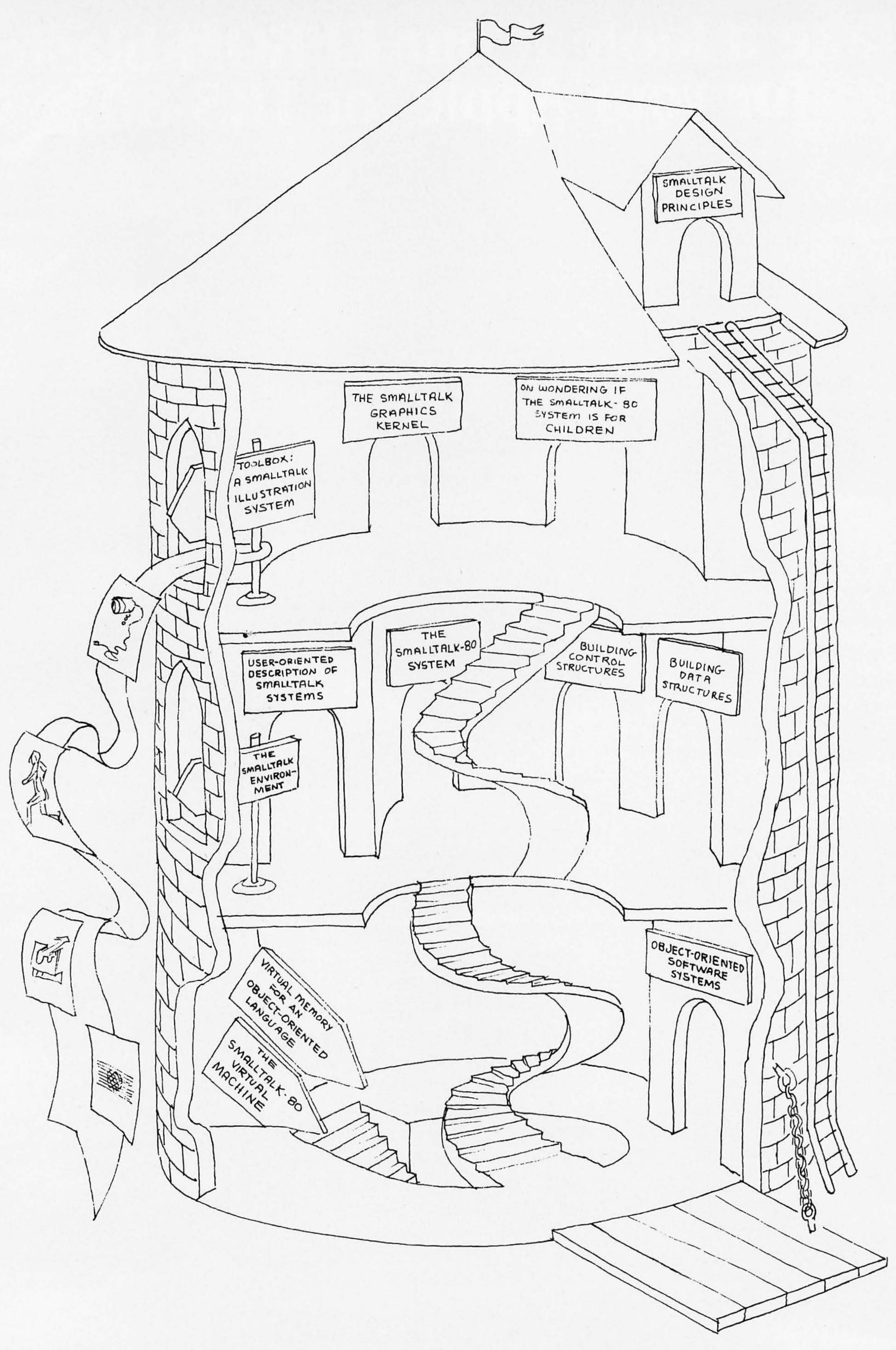


Figure 5

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Text continued from page 22:

others, knowledge of the Smalltalk-80 system and its design philosophy is a prerequisite to understanding many of them. The map in figure 5 is presented to help the reader find a course through this hitherto uncharted ivory tower.

You can begin at the drawbridge by reading Dave Robson's introduction to object-oriented programming (page 74) and then proceed by reading the description of the Smalltalk-80 language (page 36). The two examples of programming in Smalltalk-80 are likely next steps: one, by Jim Althoff, tells you how to build data structures (page 230); the other, by Peter Deutsch, describes how to build control structures (page 322). Or, you can follow a hallway to the user interface window and read Larry Tesler's description of the Smalltalk programming environment (page 90). Trygve Reenskaug offers further perspectives on providing a programming interface to a Smalltalk system (page 147).

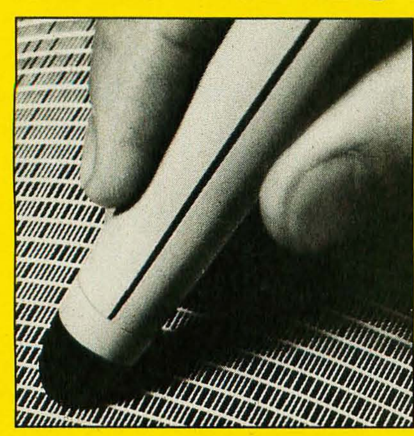
At any time, you can take the side stairs to read Dan Ingalls' presentation of the design principles behind Smalltalk (page 286). Those readers who are interested in implementation details can head for the cellar and read Glenn Krasner's article on the Smalltalk virtual machine (page 300), or Ted Kaehler's article on a Smalltalk virtual memory (page 378).

The walls of the tower are covered with visual images that will please any graphics enthusiast. Many were created by the ToolBox painting component of Smalltalk, as described in Bill Bowman and Bob Flegal's article (page 369). Greater detail about the Smalltalk graphics kernel is provided by Dan Ingalls (page 168).

Ivory towers are often associated with educational enterprises. So it is not surprising that field studies of the various versions of Smalltalk have been carried out mostly in educational settings; elementary, junior, and senior high school students as well as university students have helped us test our ideas. Joan Ross and I provide some of the history in an article exploring whether the Smalltalk-80 system is for children (page 348).

Many people have helped to build our ivory tower, to surround it with protective clouds, and then to blow some of the clouds away. All the people, past and present, of the Xerox Palo Alto Research Center contributed a brick or two. George Pake, vice president of Corporate Research, assembled the bricklayers. We especially herald the person who is responsible for laying the foundation, Alan Kay, and current members of LRG not named as article scribes: Peggy Asprey, Alan Borning, Laura Gould, Bruce Horn, Neil Jacobstein, Kim McCall, Diana Merry, Steve Putz, and Steve Weyer. Special thanks to Bert Sutherland who did the "preflight check."■

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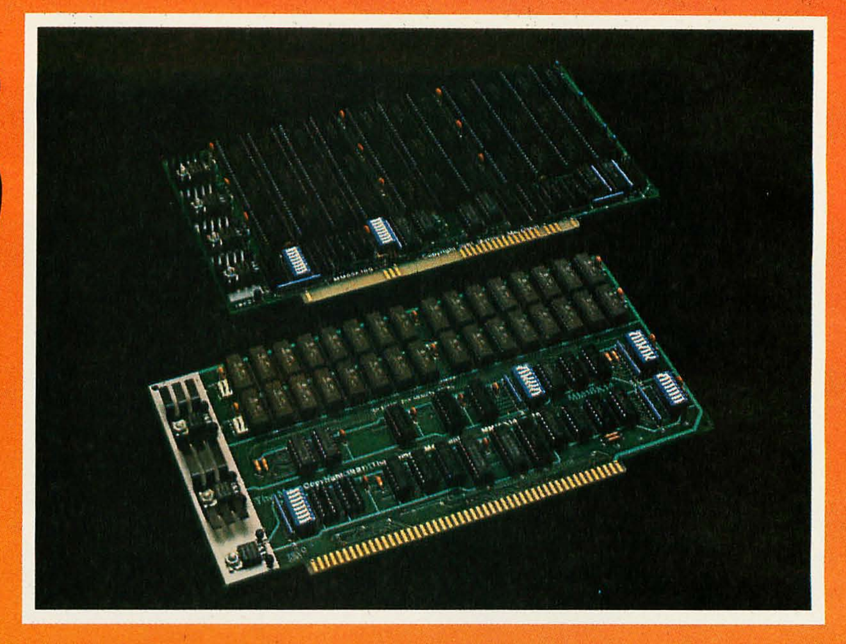
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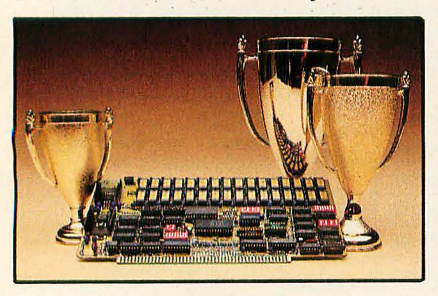
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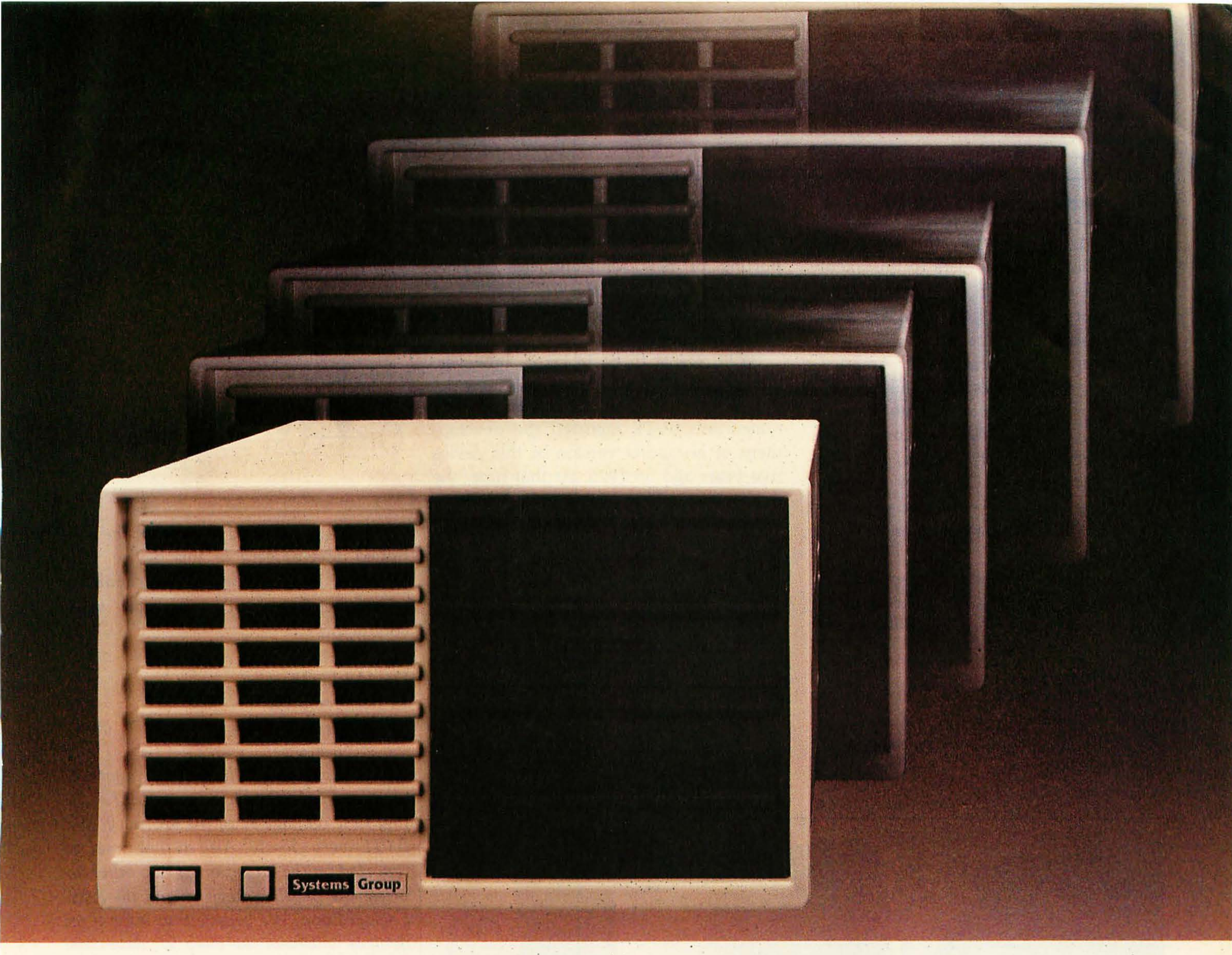
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Letters

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An advertisement in the May 1981 BYTE could cause readers to mistakenly conclude that certain products of Computer Corporation of America are available through Computers, Etc.

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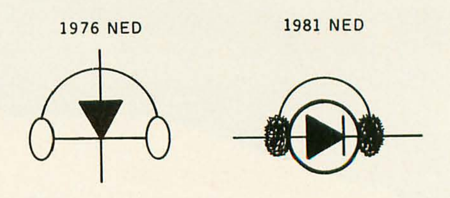
I was pleased to see BYTE's ongoing reporting of new semiconductor devices with April's "What's New?" mention of LOUD Electronics's 3N120DB NED (noise-emitting diode).

BYTE seems to be in error, however, when it says that the device is a "new development in indiscreet electronics." As I remember, BYTE reported the development of an earlier version of this device five years ago, in 1976. At that time, the device was only available in high-voltage versions and had a much shorter lifetime than the current component has.

In the 1976, BYTE said:

When connected across a +1000 V supply, it makes a loud noise (once). The NED was discovered by Igor Pravaganda, whom, you'll recall, worked many years trying to filter AC with polarized electrolytic capacitors. He'll always be remembered as the father of the confetti generator.

At that time, the schematic diagram of the device was also slightly different. I assume the drawing of the NED has been standardized to the current version in the past five years.



While I am pleased to learn of the continued development of this device, I do feel that, in the future, BYTE should be more careful in reporting of "new" semiconductors.

David J Lindbergh
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Worcester MA 01609

We have been following the development of the NED (which appeared for the first time on page 41 of the February 1976 BYTE) very closely. Also at that time, we reported on the invention of two other devices: the Shiftless Register and the Fuzz-Locked Loop. We believe that these three devices will form the basis for data-communications systems in the future. Watch upcoming issues for a report on the Fast-Fourier Stepdown Transformer. . . . **CPF**



Circle 84 on inquiry card.

April's Foolers

The hasty printing of data concerning our Black-Hole Diode is not only an invasion of our corporate security, but is not in the national interest. (See the April 1981 BYTE, page 363.)

Our device, which is covered by US patents and is classified by the National Security Council as "Top Secret," should not be pandered about in a general-circulation magazine for all to see, especially when those not friendly to our nation may learn details of this device.

Furthermore, how BYTE learned of the existence of our device is unknown to us, but be advised that stricter security has been imposed to forestall any further lapses.

Be also advised that the company BYTE lists as being responsible for creating the

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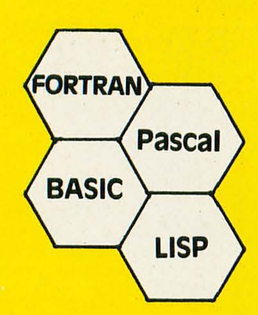
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Letters

Black-Hole Device, Spatial Regression Ltd, will shortly receive summons from our legal department.

Any repetition or further disregard for national security regarding this device or its uses in particle-beam research will bring about swift and *final* action.

J W Kelty
Chief Executive Officer
Code-7 Electronics
POB 1505
Modesto CA 95353

Each year, the BYTE staff enjoys slipping a few joke items into the April issue for our readers to find; some are subtle, some are outrageous. Response to this year's foolishness was greater than in any year past. In case you missed it, look for

"Lost Dutchman's Bug" (photo), page 302
"Black-Hole Diode" (new product), page 363
"Noise-Emitting Diode" (new product), page 364
"Slightly Used Cray-1" (unclassified ad), page 414

So you see, there's no need for "swift and final action" (gulp!)—we were just kidding! By the way, where should we return the sample device that was included with your letter? . . . CPF

Unpublished Apple Logo

With some hesitation, I'm writing this letter to inform BYTE readers of an unfortunate situation concerning the distribution of the MIT Apple Logo programming language. I've been writing Apple Logo at the Logo laboratory for the last two years as an undergraduate project. I've labored under the understanding that Apple Logo was to be placed in the public domain or licensed to software-development companies or dealers for distribution. However, for the past eight months, MIT has withheld the language from the public.

I would like to explain why. The original intent of my project was to implement a small subset of the Logo interpreter on the Apple computer. The final product actually evolved into a full-scale implementation, with features surpassing the Texas Instruments (TI) version, which also was developed at the Logo laboratory. When TI heard about this and the Apple Logo project, it reacted angrily; it fears that a Logo for the Apple would adversely affect sales of its Logo system. In fact, TI may be quite justified in its fears, for there are many people who think that Apple Logo is superior to TI Logo as an educational tool. It's rumored that Texas Instruments is depending on TI Logo to redeem the TI-99/4 home computer, which is not selling as well as expected.

Texas Instruments is a very generous friend of MIT, and some people here are embarrassed about a situation that might threaten one of its sales programs. So, in an effort to appease its corporate friend, MIT has been stalling the distribution of Apple Logo. There was a version ready for distribution at the end of last year with many improvements over the version reviewed in the June BYTE (see "Logo for Personal Computers," page 36), and since then it has been expanded and improved. But I'm extremely frustrated that MIT chooses to avoid angering Texas Instruments by compromising the efforts of one of its undergraduate students. This frustration is compounded by the fact that I feel, as do many here at the lab, that the TI-99/4 has many serious deficiencies and that the public will be cheated if forced to buy it because it is the only machine on which Logo is available.

Apple Logo is one of the finest programs that can be used on the Apple, and I would like to see it widely distributed as early as possible. Two years of my efforts went into it, as well as those of several others, and it's sad that MIT does not recognize the injustice that it is doing to myself, the Logo laboratory, and the many Apple users who would benefit from Apple Logo. If TI is afraid that its sales will be hurt, then it should fix the deficiencies in its machine and stop trying to suppress this program. I urge BYTE readers to write the Office of the Provost at MIT and request that Apple Logo be made public or licensed for distribution without delay. Thank you.

Stephen Hain
MIT Logo Laboratory
545 Technology Sq
Cambridge MA 02139

Love's Labors Lost

Whilst enjoying very much the Shakespearean research endeavours of Andrew Kalnik, it is obvious that he has missed the point. (See "Micro-Shakespeare," April 1980 BYTE, page 104 and "MicroShakespeare Revisited," April

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1981 BYTE, page 98.)

Careful scrutiny of the works of the Bard of Programmers reveals that some discarded program segments have become garbled into the text, probably as the result of bad file merges.

Take, for example, the statement

If it were done when 'tis done then 'twere well it were done quickly

or, parsing

IF I(T) WERE D(ONE) WHEN 'T IS D(ONE) THEN 'T WERE W(L) I(T) WERE D(ONE) QUICKLY

which, written as we understand it, and using X for ', gives

```
IF I(T)  = D(1)
   WHILE T(X) = D(1)
      T(X) = W(L)
      I(T) = D(1)
         QUICKLY
```

The WEND statement is missing, but it may be that QUICKLY denotes a machine-code subroutine that could have some terminating function. (Mistress Quickly is a comical character in *The Merry Wives of Windsor*—an example, perhaps, of a subroutine label being confused with a file name?)

Further research has revealed, hidden in the depths of the surviving listings, an incomplete command syntax of a lost high-level language.

Typical examples of this are

Lost Language	Modern Parlance
Armour	Chain
Billet	Log
Breach	Input
Burden	Load
Count	Cont
Curtail	Edit
Espy	Peek
Fellow	Cos
Folio	Print
Hail	Call
Inquisition	Exam
Buffet	Poke
Missives	Data
Near	Close
Peasant	Common
Scotch	Erase
Scribe	Write
Set	Put
Tally	List
Unbesmirch	Clear

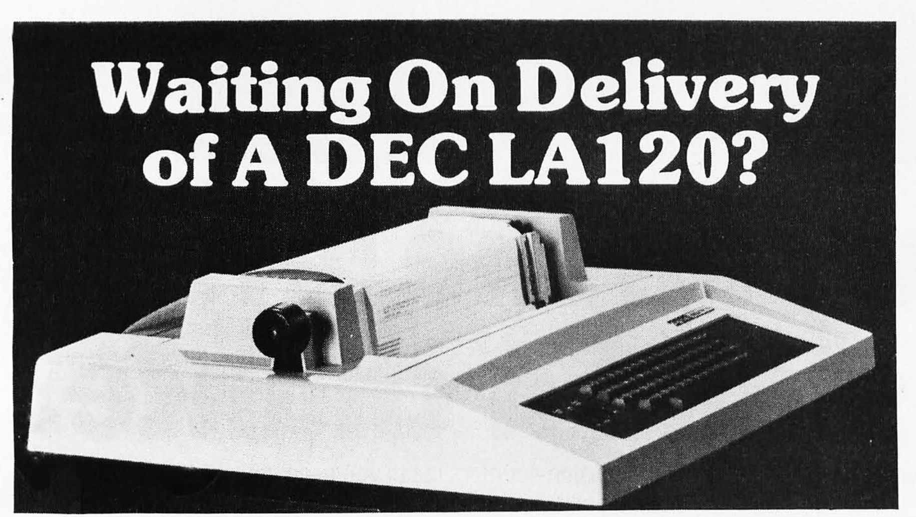
There are some commands still in use today: GOTO, END, EXIT, ERROR, RESTORE, RUN are typical, whilst the use of functions such as SIN, HEX, DIM, and FIX show the arithmetical properties of the language. It can safely be assumed that commands such as READ and AUTO were not generally implemented at this time.

Research continues, but so far it looks as if Sir Francis Drake made the first recorded visit to Silicon Valley, during which, presumably, the natives acquired the principles of his on-board navigational computer.

Ross Henderson
Systems Manager
Digital Devices Ltd
134 London Rd
Southborough, Kent,
TN4 0PL, England

It is obvious that, despite improvements in hardware, some aspects of programming never change—Shakespeare, in his time, may have suffered the "slings and arrows of outrageous fortune" just as modern programmers do. What personal-computer user has not, after seeing an advertisement for software, purchased same from The *Software* Merchant *of*

Letters continued on page 282

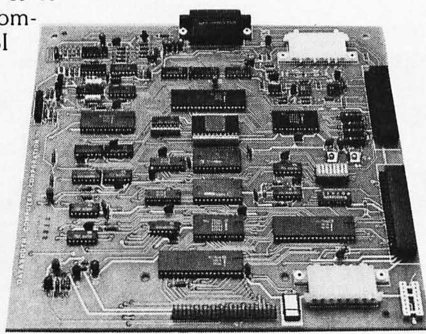


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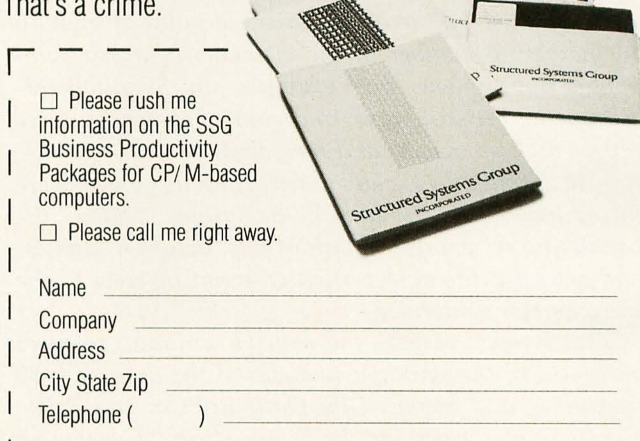
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The Smalltalk-80 System

The Xerox Learning Research Group
Xerox Palo Alto Research Center
3333 Coyote Hill Rd
Palo Alto CA 94304

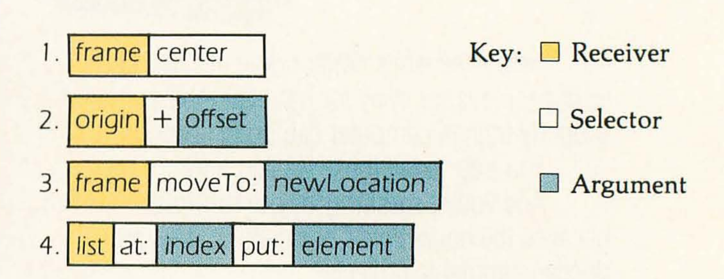
The Smalltalk-80 system represents the current state of the object-oriented point of view as it has been reduced to practice by the Xerox Learning Research Group. The Smalltalk-80 system is composed of objects that interact only by sending and receiving messages. The programmer implements a system by describing messages to be sent and describing what happens when messages are received.

The Smalltalk-80 system is the latest in a series of programming environments that have applied the object-oriented point of view more and more uniformly to the design and production of software systems. The fundamental ideas of objects, messages, and classes came from SIMULA. (See reference 1.) SIMULA allows users to create object-oriented systems, but uses the standard data/procedure-oriented ALGOL language to provide numbers, booleans, basic data structures, and control structures. The Flex system, the Smalltalk-72, Smalltalk-74, and Smalltalk-76 (see references 5, 2, and 4, respectively) systems extended the object-oriented point of view to an increasing number of the elements of a programming environment. For example, in Smalltalk-72, arithmetic, list structures, and control structures were represented as objects and messages, but classes were not. In Smalltalk-74, class descriptions as objects were introduced. The Smalltalk-76 system added the capability to express relationships between classes, and extended the object-oriented point of view to the programmer's interface.

This article presents the central semantic features and most of the syntactic features of the Smalltalk-80 system. It was prepared by Dave Robson and Adele Goldberg as scribes for the group effort of designing and implementing the system. Two forthcoming books (see reference 3) provide the full specification of the Smalltalk-80 system; in particular, the books describe the implementation of the interpreter and storage manager, and the graphical user interface.

Sending Messages—Expressions

Messages are described by *expressions,* which are sequences of characters that conform to the syntax of the Smalltalk-80 programming language. A message-sending expression describes the *receiver, selector,* and *arguments* of the message. When an expression is *evaluated,* the message it describes is transmitted to its receiver. Here are several examples of expressions describing a message to an object. (Note: color has been added to help identify the receivers, selectors, and arguments in the following examples.)



Each expression begins with a description of the receiver of the message. The receivers in these examples are described by *variable names:* frame, origin, frame, and list, respectively. Generally, at least one space must separate the parts of an expression.

Messages without arguments are called *unary messages.* A unary message consists of a single identifier called a unary selector. The first example is a unary message whose selector is center.

A *binary message* has a single argument and a selector that is one of a set of special single or double characters called *binary selectors.* For example, the common arithmetic symbols (+, −, *, and /) are binary selectors; some comparison operations are represented as double characters (eg: == for equivalence, ~= for not equal). The second example is a binary message whose argument is offset.

A *keyword message* has one or more arguments and a selector that is made up of a series of *keywords,* one preceding each argument. A keyword is an identifier with

a trailing colon. The third example is a single-argument keyword message whose selector is moveTo: and whose argument is newLocation. The fourth example is a two-argument keyword message whose selector is made up of the keywords at: and put: and whose arguments are index and element. To talk about the selector of a multiple-argument keyword message, the keywords are concatenated. So, the selector of the fourth example is at:put:.

The message receivers and arguments in the examples are described by variable names. In addition, they can also be described with *literals*. The two most common kinds of literals are integers and strings. An *integer literal* is a sequence of digits that may be preceded by a minus sign (eg: 0, 1, 156, −3, or 13772). A *string literal* is a sequence of characters between single quotes (eg: 'hi', 'John', or 'the Smalltalk-80 system'). A binary message with an integer literal as its receiver is

```
45 + count
```

A keyword message with a string literal as its argument is

```
printer display: 'Monthly Payroll'
```

When a message is sent, it invokes a method determined by the class of the receiver. The invoked method will always return a result (an object). The result of a message can be used as a receiver or argument for another message. An example of a unary message describing the receiver of another unary message is

```
window frame center
```

Unary messages are parsed left to right. The first message in this example is the unary selector frame sent to the object named window. The unary message center is then sent to the result of the expression window frame (ie: the object returned from window's response to frame).

Binary messages are also parsed left to right. An example of a binary message describing the receiver of another binary message is

```
index + offset * 2
```

The result of sending the binary message + offset to the object named index is the receiver for the binary message *2. All binary selectors have the same precedence; only the order in which they are written matters. Parentheses can be used to change the order of evaluation. A message within parentheses is sent before any messages outside the parentheses. If the previous example were written

```
index + (offset * 2)
```

the result of the binary message * 2 to offset would be used as the argument of a binary message with receiver index and selector + .

Unary messages take precedence over binary messages. If unary messages and binary messages appear together, the unary messages will be sent first. In the example

```
frame center + window offset − index
```

the result of the unary message center to frame is the receiver of the binary message whose selector is + and whose argument is the result of the unary message offset to window. The result of the + message is, in turn, the receiver of the binary message − index. Parentheses can be used to explicitly show the order of evaluation, eg: ((frame center) + (window offset)) − index. Parentheses can also be used to alter the order of evaluation. In the example

```
(center + offset) x
```

the binary message + offset would be sent before the unary message x.

Whenever keywords appear in an unparenthesized message, they compose a single selector. The example

```
window showText: 'Title' inFont: helvetica
  indented: 15
```

is a single message whose selector is showText:inFont:indented:. Because of this concatenation, there is no left-to-right parsing rule for keyword messages. If a keyword message is to be used as a receiver or argument of another keyword message, it must be parenthesized. The expression

```
frame scale: (factor max: 5)
```

describes two keyword messages. The result of the expression factor max: 5 is the argument for the scale: message to frame.

Binary messages take precedence over keyword messages. When unary, binary, and keyword messages appear in the same expression without parentheses, the unary messages are sent first, the binary messages next, and the keyword messages last. The example

```
bigFrame height: smallFrame height * 2
```

is evaluated as if it were parenthesized as follows:

```
bigFrame height: ((smallFrame height) * 2)
```

A *cascaded message expression* describes a sequence of messages to be sent to the same object. A simple message expression is a description of the receiver (ie: a variable name, literal, or expression) followed by a message (ie: a unary selector, a binary selector and argument, or a set of keywords and arguments). A cascaded message expres-

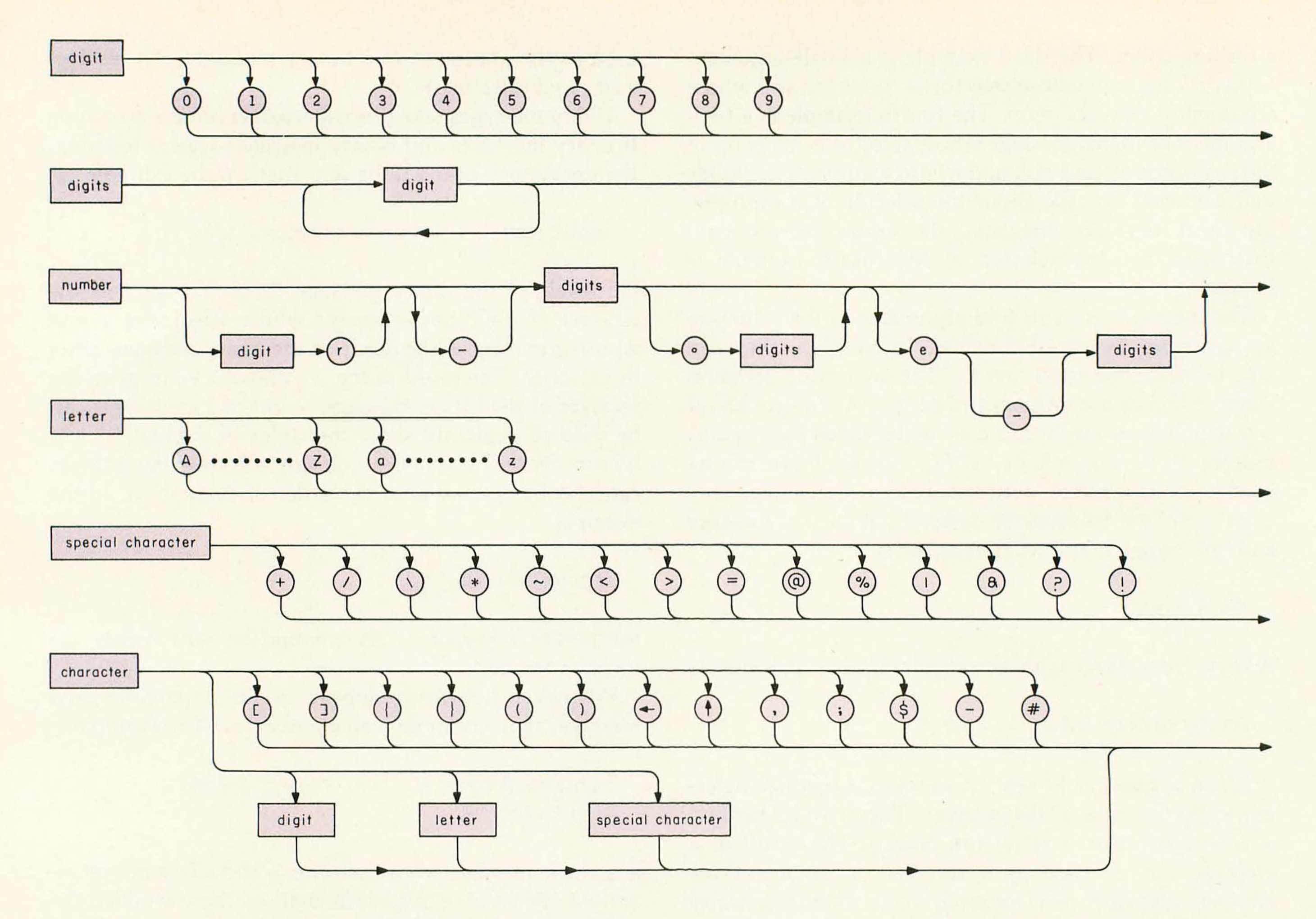


Figure 1: *Syntax diagrams for the Smalltalk-80 language.*

sion is a single description of a receiver followed by several messages separated by semicolons. For example, in the expression

```
printer newLine; print: reportTitle; space;
  print: Date today.
```

four messages are sent to the object named printer. The selectors of the four messages are newLine, print:, space, and print:. In the expression

```
window frame center: pointer location;
  width: border + contents; clear
```

three messages are sent to the object returned from the frame message to window. The selectors of the three messages are center:, width:, and clear. Without cascading, this would have been three expressions

```
window frame center: pointer location.
window frame width: border + contents.
window frame clear
```

Assigning Variables

The value of a variable can be used as the receiver or argument of a message by including its name in an expression. The value of a variable can be changed with an *assignment expression*. An assignment expression consists of a variable name followed by a left arrow (←) followed by the description of an object. When an assignment expression is evaluated, the variable named to the left of the arrow assumes the value of the object described to the right of the arrow. The new value can be described by a variable name, a literal, or a message-sending expression. Examples of assignments are

```
center ← origin
index ← 0
index ← index + 1
index ← index + 1 max: limit
```

In the last example, the message + 1 is sent to the value of the variable index, the message max: limit is sent to the result of the + 1 message, and the result of the max: limit message becomes the new value of the variable index.

A number of variables can be assigned in the same expression by including several variable names with left arrows. The expression

```
start ← index ← 0
```

makes the value of both start and index be 0.

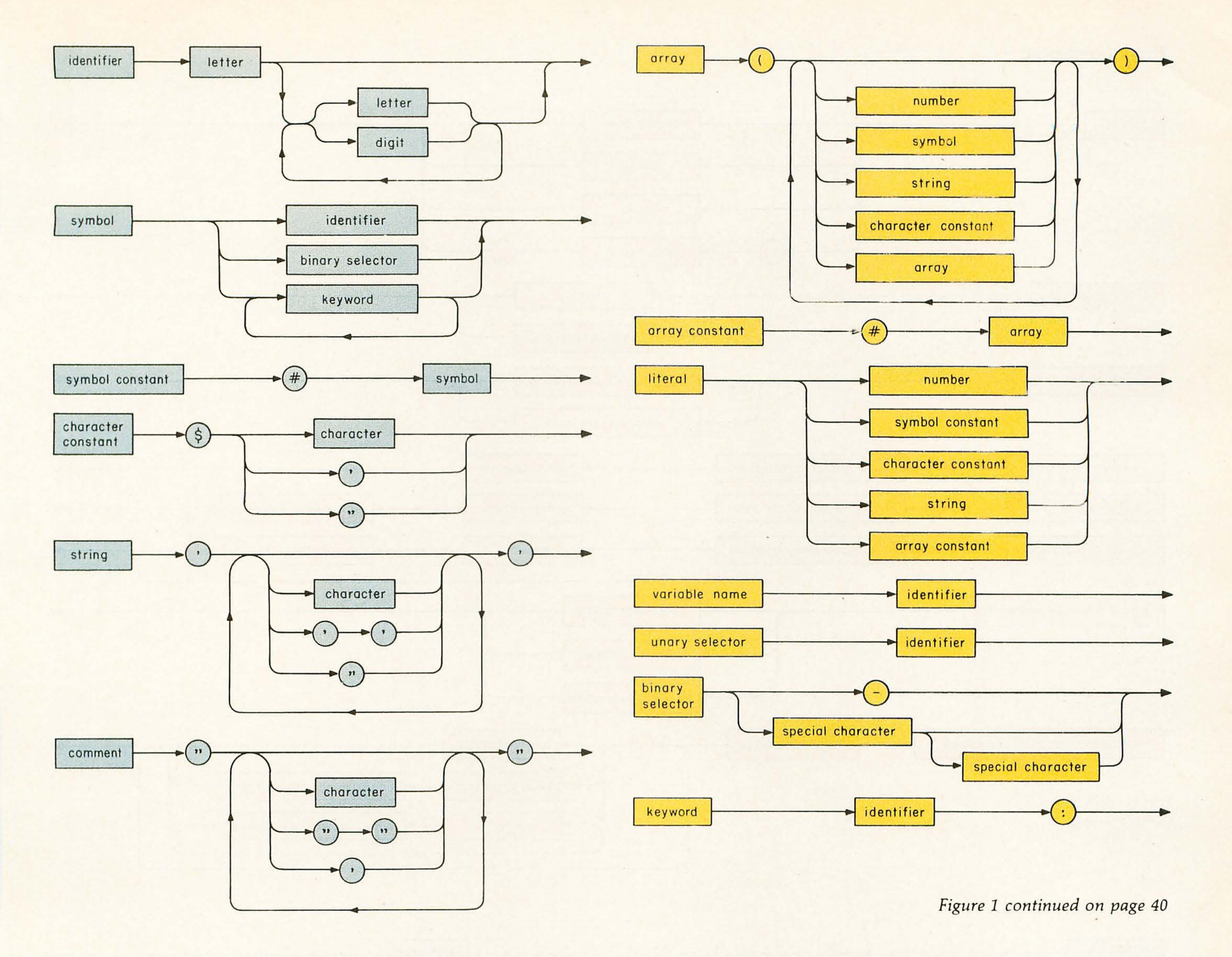


Figure 1 continued on page 40

The syntax table in figure 1 is a diagram for parsing well-formed Smalltalk-80 expressions. This table does not specify how *spaces* are treated. Spaces must not appear between digits and characters that make up a single token, nor within the specification of a number. Spaces must appear

- between a sequence of identifiers used as variables or unary selectors
- between the elements of an array in an array constant
- on either side of a keyword in a keyword expression

Spaces may optionally be included between any other elements in an expression. A carriage return or tab has the same syntactic function as a space.

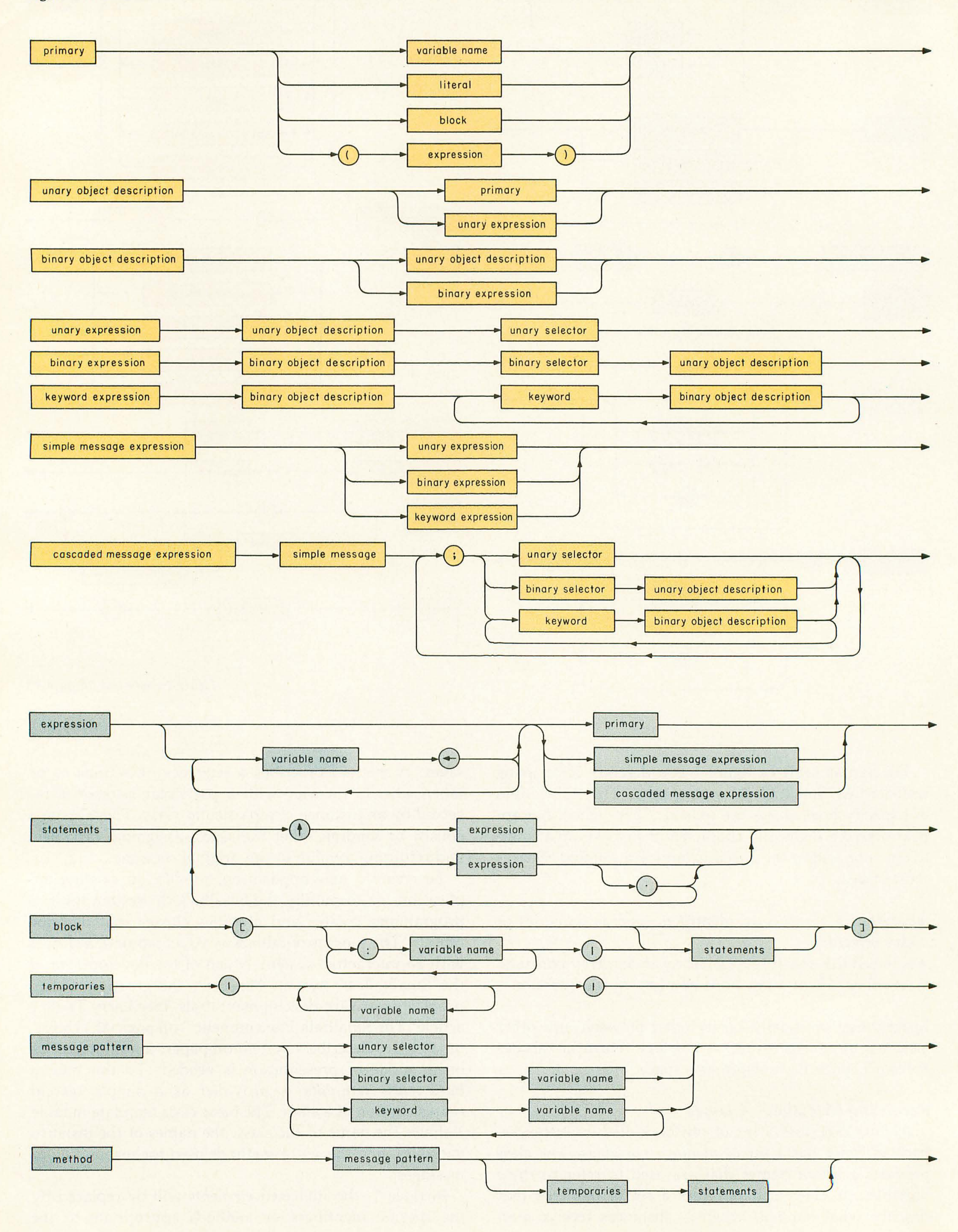
Receiving Messages—Classes

A *class* describes a set of objects called its *instances*. Each instance has a set of *instance variables*. The class provides a set of names that are used to refer to these variables. A class also provides a set of *methods* that describe what happens when its instances receive messages. A method describes a sequence of actions to be taken when a message with a particular selector is received by an instance of a particular class. These actions consist of sending other messages, assigning variables, and returning a value to the original message.

To create a new application, modify an existing application, or to modify the Smalltalk-80 system itself, a programmer creates and modifies classes that describe objects. The most profitable way to manipulate a class is with an interactive system. Much of the development of the Smalltalk-80 system has been the creation of appropriate software-development tools. (See Larry Tesler's article "The Smalltalk Environment," on page 90.) Unfortunately, to describe a system on paper, a noninteractive linear mode of presentation is needed. To this end, a *basic class template* is provided as a simple textual representation of a class. The basic class template in table 1 shows the name of the class, the names of the instance variables, and the set of methods used for responding to messages.

In table 1, the italicized elements will be replaced by the specific identifiers or methods appropriate to the

Figure 1 continued:



class name	*identifier*
instance variable names	*identifier identifier identifier*
methods	
method	
method	
method	

Table 1: *The basic class template.*

class. Names of classes begin with an uppercase letter, and names of variables begin with a lowercase letter. As an example, figure 2 shows the basic template form of a class named Point whose instances represent points in a two-dimensional coordinate system. Each instance has an instance variable named x that represents its horizontal coordinate and an instance variable named y that represents its vertical coordinate. Each instance can respond to messages that initialize its two instance variables, request the value of either variable, and perform simple arithmetic. The details of methods (in particular, the use of '|', '.' and '↑') are the subject of our next discussion.

Methods

A method has three parts:

- a *message pattern*
- some *temporary variable names*
- some expressions

The three parts of a method are separated by vertical bars (|). The message pattern consists of a selector and names for the arguments. The expressions are separated by periods (.) and the last one may be preceded by an up arrow (↑). In the method for selector + in figure 2, the message pattern is + aPoint, the temporary variable names are sumX and sumY, and there are three expressions, the last one preceded by an ↑.

Line breaks have no significance in methods; formatting is used only for purposes of aesthetics. The vertical bars and periods are delimiters of significance.

As stated earlier, each message pattern contains a selector. When a message is received by an instance, the method whose message pattern contains the same selector will be executed. For example, suppose that offset were an

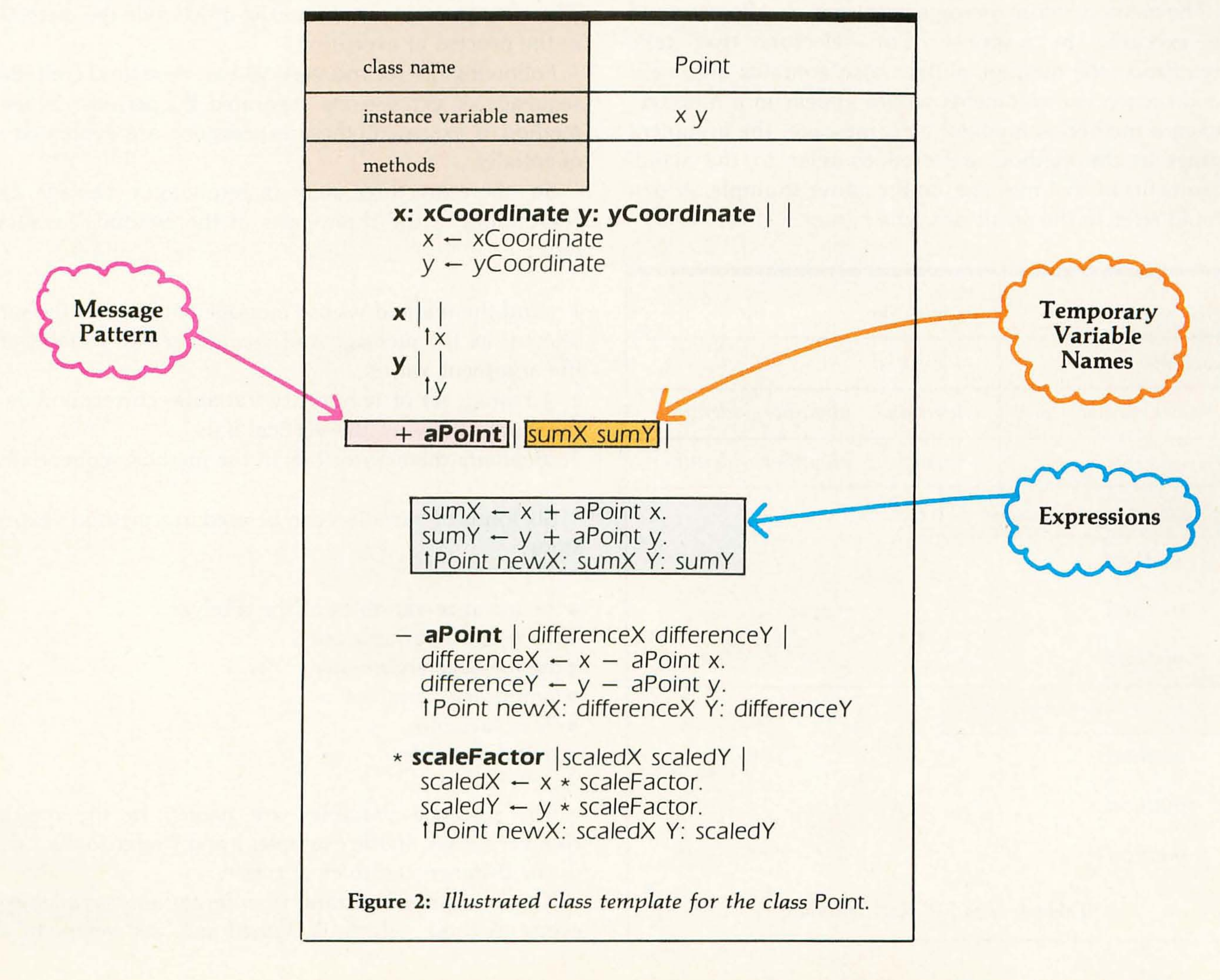


Figure 2: *Illustrated class template for the class* Point.

class name	DepositRecord
superclass	Object
instance variable names	date amount
methods	

```
of: depositAmount on: depositDate | |
    date ← depositDate.
    amount ← depositAmount
amount | |
    ↑ amount
balanceChange | |
    ↑ amount
```

Table 2: *Class template for class* DepositRecord.

class name	CheckRecord
superclass	DepositRecord
instance variable names	number
methods	

```
number: checkNumber for: checkAmount on:
  checkDate | |
    number ← checkNumber.
    date ← checkDate.
    amount ← checkAmount
of: anAmount on: aDate | |
    self error:
      'Check records are initialized with
    number:for:on:'
balanceChange | | ↑ 0 − amount
```

Table 3: *Class template for class* CheckRecord.

instance of Point in the expression

offset + frame center

The method whose message pattern is + aPoint would be executed in response. For selectors that take arguments, the message pattern also contains *argument names* wherever arguments would appear in a message. When a method is invoked by a message, the argument names in the method are used to refer to the actual arguments of that message. In the above example, aPoint would refer to the result of frame center.

class name	*identifier*		
superclass	*identifier*		
instance variable names	*identifier*	*identifier*	*identifier*
class variable names	*identifier*	*identifier*	*identifier*
class messages and methods			
method			
method			
method			
instance messages and methods			
method			
method			
method			

Table 4: *The full class template.*

Following the message pattern, a method can contain some *temporary variable names* between vertical bars. When a method is executed, a set of variables is created that can be accessed by the temporary variable names. These temporary variables exist only while the method is in the process of execution.

Following the second vertical bar, a method contains a sequence of expressions separated by periods. When a method is executed, these expressions are evaluated sequentially.

So, there are three steps in receiving a message, corresponding to the three parts of the method. Smalltalk will

1. *Find* the method whose message pattern has the same selector as the message and *create* a set of variables for the argument values.
2. *Create* a set of temporary variables corresponding to the names between the vertical bars.
3. *Evaluate* the expressions in the method sequentially.

Six kinds of variables can be used in a method's expressions:

- the instance variables of the receiver
- the pseudo-variable self
- the message arguments
- temporary variables
- class variables
- global variables

The instance variables are named in the message receiver's class. In the example, x and y refer to the values of the instance variables of offset.

There is an important *pseudo-variable* available in every method, which is named self. self refers to the

receiver of the message that invoked the method. It is called a pseudo-variable because its value can be accessed like a variable, but its value cannot be changed using an assignment expression. In the example, self refers to the same object as offset during the execution of the method associated with +.

Arguments and temporary variables are similar, in that the names for both are declared in the method itself and they both exist only during the method's execution. However, unlike arguments, temporary variables are not automatically initialized. The values of temporary variables can be changed with an assignment expression.

Class variables are shared by all instances and the class itself. Names for the class variables are shown in the full class template in an entry called "class variable names" (see table 4). Although they are variables and their values can be changed, they are typically treated as constants, initialized when the class is created, and then simply used by the instances. For example, if the class of floating-point numbers wanted to provide trigonometric functions, it might want to define a variable called pi to be used in any of its methods.

Global variables are shared by all objects. A global dictionary, called Smalltalk, holds the names and values of these variables. The classes in the system, for example, are the values of global variables whose names are the class names. With the exception of variables used to reference system resources, few global variables exist in the Smalltalk-80 system. Programming style that depends on user-defined globals is generally discouraged.

If the last expression in a method is preceded by an ↑, the message that invoked the method takes on the value of this expression. If an ↑ does not precede the last expression, the value of the message is simply the receiver of the message. For example, the x:y: message to a Point (see figure 2) behaves as if it had been written

```
x: xCoordinate y: yCoordinate | |
    x ← xCoordinate.
    y ← yCoordinate.
    ↑ self
```

Methods can contain comments anywhere. A *comment* is a sequence of characters delimited by double quotes. Two consecutive double quotes are used to embed a double quote within a comment. The methods in class Point were purposely written in a verbose style to provide examples. The messages for + could have been written

```
+ aPoint | |
    ↑ Point newX: x + aPoint x Y: y + aPoint y
```

The basic class template presents only the most important attributes of a class. The complete description of a class is provided by the *full class template*, described in the next section.

Inheritance

The basic template allows a class to be described independently of other classes. It ignores inheritance among classes. The full class template, however, takes inheritance into account. (See table 4.) With it, a class can be described as a modification of another class called its *superclass*. All classes that modify a particular class are called its *subclasses*. A subclass inherits the instance variable names and methods of its superclass. A subclass can also add instance variable names and methods to those it inherits. The instance variable names added by the subclass must differ from the instance variable names of the superclass. The subclass can *override* a method in the superclass by adding a message with the same selector. Instances of the subclass will execute the method found in the subclass rather than the method inherited from the superclass.

To assemble the complete description of a class, it is necessary to look at its superclass, its superclass's superclass, and so on, until a class with no superclass is encountered. There is only one such class in the system (ie: without a superclass), and its class name is Object. All classes ultimately inherit methods from Object. Object has no instance variables. The set of classes linked through the superclass relation is called a *superclass chain*. The full class template has an entry called "superclass" that specifies the initial link on the class's superclass chain.

As an example, we might describe a class, DepositRecord, whose instances are records of bank account deposits. Each instance has two instance variables representing the date and amount of the deposit. The class template is shown in table 2.

class name	CheckRecord
superclass	DepositRecord
instance variable names	number
class messages and methods	

```
number: checkNumber for: checkAmount on:
  checkDate | |
    ↑ self new number: checkNumber
               for: checkAmount
               on: checkDate
```

instance messages and methods

```
number: checkNumber for: checkAmount on:
  checkDate | |
    super of: checkAmount on: checkDate.
    number ← checkNumber

of: anAmount on: aDate | |

    self error: 'Check records are initialized with
      number:for:on:'
balanceChange | | ↑ 0 – amount
```

Table 5: *Full class template for class* CheckRecord.

A class, CheckRecord, whose instances are records of checks written on an account is a subclass of DepositRecord; this new class adds an instance variable that represents the check number. The class template is shown in table 3.

An instance of CheckRecord has three instance variables. It inherits the amount message, adds the number:for:on: message, and overrides the balanceChange and of:on: messages. The of:on: method contains a single expression in which the message error: 'Check records are initialized with number:for:on:' is sent to the pseudo-variable self. The method for error: is found in the superclass of DepositRecord, which is the class Object; the response is to stop execution and to display the string literal argument to the user.

An additional pseudo-variable available in a method's expressions is super. It allows a subclass to access the methods in its superclass that have been overridden in the subclass description. The use of super as the receiver of a message has the same effect as the use of self, except that the search for the appropriate message starts in the superclass, not the class, of the receiver.

For example, the method associated with number:for:on in CheckRecord might have been defined as

```
number: checkNumber for: checkAmount on:
checkDate | |
    super of: checkAmount on: checkDate.
    number ← checkNumber
```

Metaclasses

Since a class is an object, there is a different class that describes it. A class that describes a class is called a *metaclass*. Thus, a class has its own instance variables that represent the description of its instances; it responds to messages that provide for the initialization and modification of this description. In particular, a class responds to a message that creates a new instance. The unary message new creates a new instance whose instance variables are uninitialized. The object nil indicates an uninitialized value.

The classes in the system might all be instances of the same class. However, each class typically uses a slightly different message protocol to create initialized instances. For example, the last expression in the method associated with + in class Point (see figure 2) was

```
Point newX: sumX Y: sumY
```

newX:Y: is a message to Point, asking it to create a new instance with sumX and sumY as the values of the new instance's instance variables. The newX:Y: message would not mean anything to another class, such as DepositRecord or CheckRecord. So, these three classes can't be instances of the same class. All classes have a lot in common, so their classes are all subclasses of the same class. This class is named Class. The subclasses of Class are called *metaclasses*.

The newX:Y: message in Point's metaclass might be implemented as

```
newX: xValue Y: yValue | |
    ↑ self new x: xValue y: yValue
```

The new message was inherited by Point's metaclass from Class. One reason for having metaclasses is to have a special set of methods for each class, primarily messages for initializing class variables and new instances. These methods are displayed in the full class-template form shown in table 4; they are distinguished from the methods for messages to the instances of the class. The two categories are "class messages and methods" and "instance messages and methods," respectively. Methods in

class name	Point
superclass	Object
instance variable names	x y
class variable names	pi
class messages and methods	

```
instance creation
newX: xValue Y: yValue | |
    ↑ self new x: xValue
                y: yValue
newRadius: radius Angle: angle | |
    ↑ self new x: radius * angle sin
                y: radius * angle cos

class initialization
setPI | | pi ← 3.14159
```

instance messages and methods

```
accessing
x: xCoordinate y: yCoordinate | |
    x ← xCoordinate.
    y ← yCoordinate
x | | ↑x
y | | ↑y
radius | | ↑((x * x) + (y * y)) squareRoot
angle | | ↑(x/y) arctan

arithmetic
+ aPoint | | ↑Point newX: x + aPoint x
                       Y: y + aPoint y
- aPoint | | ↑Point newX: x - aPoint x
                       Y: y - aPoint y
* scaleFactor | | ↑Point newX: x * scaleFactor
                            Y: y * scaleFactor
circleArea | r |
    r ← self radius.
    ↑ pi * r * r
```

Table 6: *Full class template for class* Point.

the category "class messages and methods" are associated with the metaclass; those in "instance messages and methods" are associated with the class.

If there are no class variables for the class, the "class variable name" entry is omitted. So, CheckRecord might be described as shown in table 5.

It is often desirable to create subcategories within the categories "class messages and methods" and "instance messages and methods." Moreover, the order in which the categories or subcategories are listed is of no significance. (The notion of categories is simply a pretty printing" technique; it has no semantic significance.)

Returning to the example of class Point, if the instance methods of class Point include subcategories *accessing* and *arithmetic*, the template for Point might appear as shown in table 6.

When the class Point is defined, the expression

```
Point setPi
```

should be evaluated in order to set the value of the single class variable.

A Point might be created and given a name by evaluating the expression

```
testPoint ← Point newX: 420 Y: 26
```

The new Point, testPoint, can then be sent the message circleArea:

```
testPoint circleArea
```

or used in a more complex expression:

```
(testPoint * 2) circleArea
```

Primitive Routines

The response to some messages in the system may be performed by a *primitive routine* (written in the implementation language of the machine) rather than by evaluating the expressions in a method. The methods for these messages indicate the presence of such a primitive routine by including <primitive> before the first expression in the method. A major use of primitive methods is to interact with the machine's input/output devices.

An example of a primitive method is the new message to classes, which returns a new instance of the receiver.

```
new | | <primitive>
```

This particular primitive routine always produces a result. If there are situations in which a primitive routine cannot produce a result, the method will also contain some expressions. If the primitive routine is successful in responding to the message, it will return a value and the expressions in the method will not be evaluated. If the primitive routine encounters difficulty, the expressions will be evaluated as though the primitive routine had not been specified.

Another example of a message with a primitive response is a message with the selector + sent to a SmallInteger

```
+ aNumber | | <primitive>
    self error: 'SmallInteger addition has failed'
```

One reason this primitive might fail to produce a result is that the argument is not a SmallInteger. In the example, this would produce an error report. In the actual Smalltalk-80 system, an attempt is made to check and see if the argument were another kind of number for which a result could be produced.

Indexed Instance Variables

An object's instance variables are usually given names by its class. The names are used in methods of the class to refer to the values of the instance variables. Some objects also have a set of instance variables that have no names and can only be accessed by messages. The instance variables are referred to by an integral *index*. Indexable objects are used to implement the classes in the system that represent collections of other objects, such as arrays and strings.

The messages to access indexed instance variables have

class name	Array
superclass	IndexedCollection
indexable instance variables	
class messages and methods	

```
instance creation
with: anElement | |
    ↑(self new: 1) at: 1 put: anElement
with: firstElement with: secondElement
    | anArray |
    anArray ← self new: 2.
    anArray at: 1 put: firstElement.
    anArray at: 2 put: secondElement.
    ↑anArray
```

instance messages and methods

```
accessing
at: anInteger | |
    <primitive>
    self error: 'index out of range'

at: anInteger put: anElement | |
    <primitive>
    self error: 'index out of range'

funny stuff
embed | |
    ↑Array with: self
```

Table 7: *Full class template for class* Array.

selectors at: and at:put:. For example

```
list at: 1
```

returns the first indexed instance variable of list. The example

```
list at: 4 put: element
```

stores element as the value of the fourth indexed instance variable of list. The at: and at:put: messages invoke primitive routines to load or store the value of the indicated variable. The legal indices run from one to the number of indexable variables in the instance. The at: and at:put: messages are defined in class Object and, therefore, can be understood by all objects; however, only certain classes will create instances with indexable instance variables. These classes will have an additional line in the class template indicating that the instances contain *indexable instance variables*. As an example, we show a part of the template for class Array in table 7.

Each instance of a class that allows indexable instance variables may have a different number of them; such instances are created using the new: message to a class, whose argument tells the number of indexable variables. The number of indexable instance variables an instance has can be found by sending it the message size. A class whose instances have indexable instance variables can also have named instance variables. All instances of any class will have the same number of named instance variables.

Control Structures and Blocks

The two control structures in the Smalltalk-80 system described so far are

- the sequential execution of expressions in a method
- the sending of messages that invoke other methods that eventually return values

All other control structures are based on objects called *blocks*. Like a method, a block is a sequence of expressions, the last of which can be preceded by an up arrow (↑). The expressions are delimited by periods; they may be preceded by one or more identifiers with leading colons. These identifiers are the *block arguments*. Block arguments are separated from expressions by a vertical bar.

Whenever square brackets are encountered in a method, a block is created. Evaluation of the expressions inside the square brackets is deferred until the block is sent the message value or a message whose selector is a concatenation of one or more occurrences of the keyword value:. Control structures are implemented as messages with receivers or arguments that are blocks. The methods for carrying out these control-structure messages involve sending the blocks patterns of value messages.

In the Smalltalk-80 system, there are two types of primitive control messages: conditional selection of blocks, ifTrue:ifFalse:, and conditional iteration of blocks, whileTrue: and whileFalse:.

The representation of conditions in the Smalltalk-80 system uses distinguished boolean objects named false and true. The first type of primitive control message provides for conditional selection of a block to be executed. This is similar to the IF . . . THEN . . . ELSE of ALGOL-like languages. The expression

```
queue isEmpty ifTrue: [index ← 0]
              ifFalse: [index ← queue next]
```

evaluates the expressions in the first block if the receiver is true and evaluates the expressions in the second block if the receiver is false. Two other forms of conditional selection provide only one alternative

```
queue isEmpty ifTrue: [index ← 0].
queue isEmpty ifFalse: [index ← queue next].
```

When ifTrue: is sent to false, it returns immediately without executing the block. When ifFalse: is sent to true, the block is not executed.

The second type of primitive control message repeatedly evaluates the expressions in a block as long as some condition holds. This is similar to the WHILE and UNTIL statements in ALGOL-like languages. This type of control message is a message to a block; the receiver, the block, evaluates the expressions it contains and determines whether or not to continue on the basis of the value of the last expression. The first form of this control message has selector whileTrue:. The method for whileTrue: repeatedly executes the argument block as long as the receiver's value is true. For example,

```
[index < = limit] whileTrue: [self process: list at: index.
                              index ← index + 1]
```

The binary message < = is understood by objects representing magnitudes. The value returned is the result of comparing whether the receiver is less than or equal to (< =) the argument.

The second conditional iteration message has selector whileFalse:. The method for whileFalse: repeatedly executes the argument block as long as the receiver's value is false. For example,

```
[queue isEmpty] whileFalse: [self process: queue next]
```

The messages whileTrue and whileFalse to a block provide a shorthand notation for messages of the form whileTrue: aBlock and whileFalse: aBlock, if the argument aBlock is an empty block.

Block arguments allow one or more of the variables inside the block to be given new values each time the block is executed. Instead of sending the block the message value, messages with selectors value: or value:value:, and

so on, are sent to the block. The arguments of the value: messages are assigned to the block arguments (in order) before the block expressions are evaluated.

As an example, classes with indexed instance variables could implement a message with selector do: that takes a block as an argument and executes it once for every indexed variable. The block has a single block argument; the value of the appropriate indexed variable is passed to it for each execution. An example of the use of such a message is

```
list do: [ :element | self process: element]
```

The message might be implemented as

```
do: aBlock | index |
   index ← 1.
   [index < = self size] whileTrue:
        [aBlock value: (self at: index).
         index ← index + 1]
```

Similar control messages can be implemented for any class. As an example, a simple repetition could be provided by a timesRepeat: aBlock message to instances of class Integer

```
timesRepeat: aBlock | index |
   index ← 1.
   [index < = self] whileTrue:
        [aBlock value.
         index ← index + 1]
```

Examples of implementing other control messages are given in L Peter Deutsch's article "Building Control Structures in the Smalltalk-80 System," on page 322.

The Smalltalk-80 System: Basic Classes

The Smalltalk-80 *language* provides a uniform syntax for retrieving objects, sending messages, and defining classes. The Smalltalk-80 *system* is a complete programming environment that includes many actual classes and instances. In support of the uniform syntax, this system includes class descriptions for Object, Class, Message, CompiledMethod, and Context, whose subclasses are BlockContext and MethodContext. Multiple independent processes are provided by classes ProcessorScheduler, Process, and Semaphore. The special object nil is the only instance of class UndefinedObject. These classes comprise the *kernel* Smalltalk-80 system.

The system also includes class descriptions to support basic data structures; these are numerical and collection classes. The class Number specifies the protocol appropriate for all numerical objects. Its subclasses provide specific representations of numbers. The subclasses are Float, Fraction, and Integer. For a variety of reasons, there are both SmallIntegers and LargeIntegers; of these, there are LargePositiveIntegers and LargeNegativeIntegers.

Class Collection specifies protocol appropriate to objects representing collections of objects. These include Bag, Set, OrderedCollection, LinkedList, MappedCollection, SortedCollection, and IndexedCollection. The latter provides protocol for objects with indexable instance variables. It has subclasses String and Array. Elements of a string are instances of class Character; bytes are stored in instances of ByteArray. A subclass of String is Symbol; a subclass of Set is Dictionary (a set of Associations).

Interval is a subclass of Collection with elements representing an arithmetic progression. Intervals can be created by sending the message to: or to:by: to Integer. So, the expressions 1 to: 5 by: 1 and 1 to: 5 each create a new Interval representing 1, 2, 3, 4, 5. As a Collection, Interval responds to the enumeration message do:. For example, in

```
(1 to: 5) do: [:index | anArray at: index put: index * 2]
```

the block argument index takes on successive values 1, 2, 3, 4, 5.

For programmer convenience, an Integer also responds to the messages to:do: and to:by:do:, allowing the parentheses in interval enumeration expressions to be omitted.

The ability to stream over indexed or ordered collections is provided by a hierarchy based on class Stream, including ReadStream, WriteStream, and ReadAndWriteStream. A file system, local or remote, is then implementable as a subclass of these kinds of Streams.

Since instances of the system classes described above are used in the implementation of all applications, an understanding of their message protocol is as necessary to understanding an implementation as an understanding of the language syntax. These system classes are fully described in the forthcoming Smalltalk books.

In addition to the basic data-structure classes, the Smalltalk-80 system includes class descriptions to support interactive graphics (forms and images and image editors, text and text editors), networking, standard files, and hard-copy printing. A complete Smalltalk-80 system contains about sixty class definitions, not including a variety of windows or views, menus, scrollbars, and the metaclasses. Many of these are discussed in companion articles in this issue. (See Daniel H H Ingalls's "The Design Principles Behind Smalltalk," page 286, and Larry Tesler's "The Smalltalk Environment," page 90.)

The important thing to note is that each of these class descriptions is implemented in the Smalltalk-80 language itself. Each can be examined and modified by the programmer. Some of the class descriptions contain methods that reference primitive methods; only these methods are implemented in the machine language of the implementation machine. It is a fundamental part of the philosophy of the system design that the programmer have such complete access. In this way, system designers, such as members of the Xerox Learning Research Group, are able to build the next Smalltalk in the complete context of Smalltalk itself. ■

References

1. Birtwistle, Graham; Ole-Johan Dahl; Bjorn Myhrhaug; and Kristen Nygaard. *Simula Begin*. Philadelphia: Auerbach, 1973.
2. Goldberg, Adele and Alan Kay, editors. *Smalltalk-72 Instructional Manual*. Xerox PARC technical report, March 1976 (out of print).
3. Goldberg, Adele; David Robson; and Daniel H H Ingalls. *Smalltalk-80: The Language and Its Implementation* and *Smalltalk-80: The Interactive Programming Environment*, 1981 (books forthcoming).
4. Ingalls, Daniel H H. "The Smalltalk-76 Programming System: Design and Implementation." In *Proceedings of the Principles of Programming Languages Symposium*, January 1978.
5. Kay, Alan. *The Reactive Engine*. Ph.D. Thesis, University of Utah, September, 1969 (University Microfilms).

Glossary

Editor's Note: *This glossary provides concise definitions for many of the keywords and concepts related to Smalltalk-80. These definitions will be most useful if you first read the introductory Smalltalk articles. . . .* **GW**

General Terminology

object — *a package of information and descriptions of its manipulation*

message — *a specification of one of an object's manipulations*

method — *a procedure-like entity; the description of a sequence of actions to be taken when a message is received by an object*

class — *a description of one or more similar objects*

instance — *an object described by a particular class*

method dictionary — *a set of associations between message selectors and methods; included in each class description*

metaclass — *a class whose (single) instance is itself a class*

subclass — *a class that is created by sharing the description of another class, often modifying some aspects of that description*

Syntax Terminology

message receiver — *the object to be manipulated, according to a message*

message sender — *the object requesting a manipulation*

message selector — *a symbolic name that describes a desired manipulation of an object*

message argument — *one of the objects specified in a message that provides information needed so that a message receiver can be manipulated appropriately*

unary message — *a message without arguments*

binary message — *a message with a single argument and a selector that is one of a set of special single or double characters*

keyword message — *a message that has one or more arguments and a selector made up of a series of identifiers with trailing colons, one preceding each argument*

block — *a literal method; an object representing a sequence of actions to be taken at a later time, upon receiving an "evaluation" message (such as one with selector* value *or* value:*)*

Semantics

instance variable — *a variable that is information used to distinguish an instance from other instances of the same class*

class variable — *a variable shared by all instances of a class and the class itself*

named variable — *an instance variable that is given a name in the class of the instance; the name is used in methods of the class*

indexed variable — *an instance variable with no name, accessed by message only; referred to by an integer (an index)*

global or pool variable — *a variable shared by instances of several classes; a system example is* Smalltalk*, a dictionary that includes references to all the defined classes*

temporary variable — *a variable that exists only while the method in which it is declared is in the process of execution*

pseudo-variable — *a variable available in every method without special declaration, but whose value cannot be changed using an assignment. System examples are* self*,* super *and* thisContext.

nil — *a special object, the only instance of class* UndefinedObject

Implementation Terminology

field — *the memory space in which the value of an object's variable is stored*

bytecode — *a machine instruction for the virtual machine*

object pointer — *a reference to an object*

reference count — *of an object, is the number of objects that point to it (ie: that contain its object pointer)*

Circle 336 on inquiry card. →

Robots:
the future arrives...

Scene: *An asteroid mining team of the 21st century. Not a human team, but a team of self-replicating intelligent robots.*

1961 Enter the first industrial robot—blind and unable to respond to its environment—capable only of unvarying, repetitive tasks.

1975 Robots with touch sensing begin to do precision assembly.

1981 Robots are no longer blind—silhouette vision arrives.

1982 Robots feel with an artificial skin.

1986 Robots adapt to the unstructured human environment.

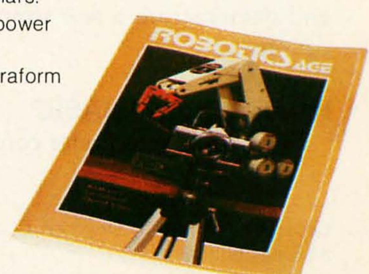
1987 Reasoning robots hear and speak human speech.

1990 Walking robots explore the surface of Mars.

1996 Orbiting robot factories construct solar power stations.

2000 and beyond: Self-replicating robots terraform the cosmos.

This future is unfolding today exclusively in the pages of *Robotics Age*. Every two months we bring you the latest state-of-the-art robotic technology—from artificial intelligence, to automated robotic factories, to personal robots. Join us in the robotics age.



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Build a Z8-Based Control Computer with BASIC, Part 2

Steve Ciarcia
POB 582
Glastonbury CT 06033

The Z8-BASIC Microcomputer system described in this two-part article is unlike any computer presently available for dedicated control applications. Based on a single-chip Zilog Z8 microcomputer with an onboard tiny-BASIC interpreter, this unit offers an extraordinary amount of power in a very small package. It is no longer necessary to use expensive program-development systems. Computer control can now be applied to many areas where it was not previously cost-effective.

The Z8-BASIC Microcomputer is intended for use as an intelligent controller, easy to program and inexpensive enough to dedicate to specific control tasks. It can also serve as a low-cost tiny-BASIC computer for general interest. Technical specifications for the unit are shown in the "At a Glance" box on page 52.

Last month I described the design of the Z8-BASIC Microcomputer hardware and the architectures of the Z8671 microcomputer component and Z6132 32 K-bit Quasi-Static Memory. This month I'd like to continue the description of the tiny-BASIC interpreter, discuss how the BASIC program is stored in memory, and demonstrate a few simple applications.

Process-Control BASIC

The BASIC interpreter contained in ROM (read-only memory) within the Z8671 is officially called the Zilog BASIC/Debug monitor. It is essentially a 2 K-byte integer BASIC which has been optimized for speed and flexibility in process-control applications.

There are 15 keywords: GOTO, GO@, USR, GOSUB, IF...THEN, INPUT, IN, LET, LIST, NEW, REM, RUN, RETURN, STOP, PRINT (and PRINT HEX). Twenty-six numeric variables (A through Z) are supported; and numbers can be ex-

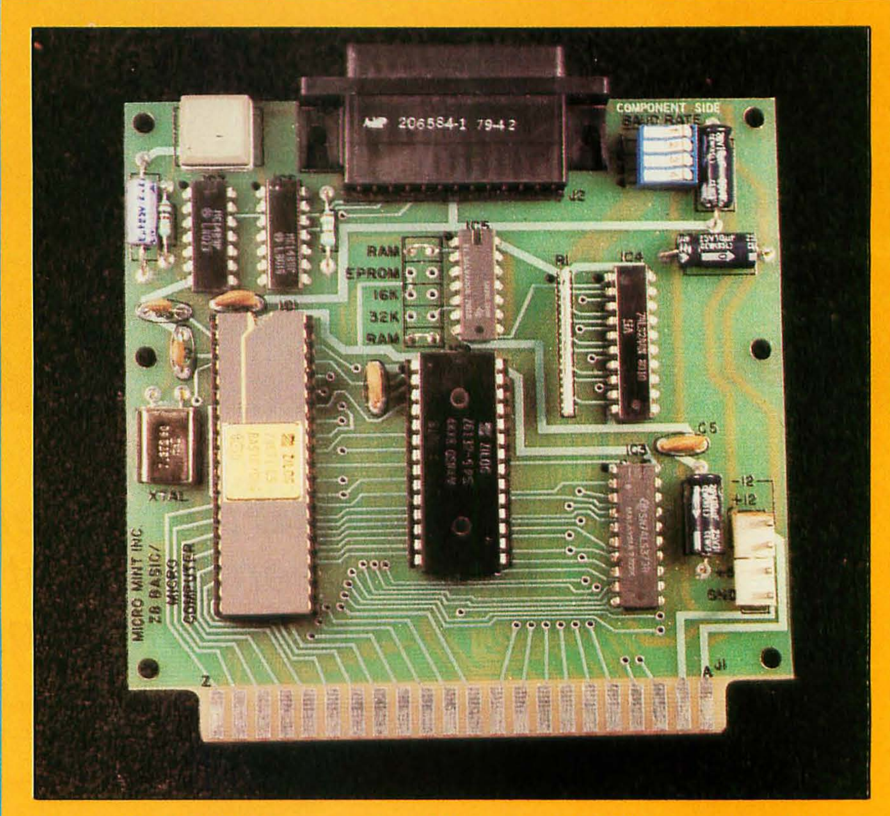


Photo 1: *Z8-BASIC Microcomputer. With the two "RAM" jumpers installed, it is configured to operate programs residing in the Z6132 Quasi-Static Memory. A four-position DIP (dual-inline pin) switch (at upper right) sets the serial data rate for communication with a user terminal connected to the DB-25S RS-232C connector on the top center. The reset button is on the top left.*

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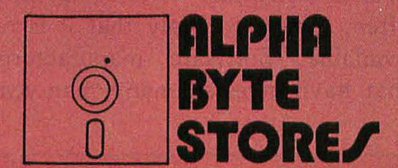
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pressed in either decimal or hexadecimal format. BASIC/Debug can directly address the Z8's internal registers and all external memory. Byte references, which use the "@" character followed by an address, may be used to modify a single register in the processor, an I/O port, or a memory location. For example, @4096 specifies decimal memory location 4096, and @%F6 specifies the port-2 mode-control register at decimal location 246. (The percent symbol indicates that the characters following it are to be interpreted as a hexadecimal numeral.) To place the value 45 in memory location 4096, the command is simply, @4096=45 (or @%1000=%2D).

Command abbreviations are standard with most tiny-BASIC interpreters, but this interpreter allows some extremes if you want to limit program space. For example:

```
IF 1>X THEN GOTO 1000
        can be abbreviated
IF 1>X 1000

PRINT"THE VALUE IS ";S
        can be abbreviated
"THE VALUE IS ";S

IF X=Y THEN IF Y=Z
THEN PRINT "X=Z"
        can be abbreviated
IF X=Y IF Y=Z "X=Z"
```

One important difference between most versions of BASIC and Zilog's BASIC/Debug is that the latter allows variables to contain statement numbers for branching, and variable storage is not cleared before a program is run. Statements such as GOSUB X or GOTO A*E−Z are valid. It is also possible to pass values from one program to another. These variations serve to extend the capabilities of BASIC/Debug.

In my opinion, the main feature that separates this BASIC from others is the extent of documentation supplied with the Z8671. Frequently, a computer user will ask me how he can obtain the source-code listing for the BASIC interpreter he is using. Most often, I have to reply that it is not available. Software manufacturers that have invested many man-years

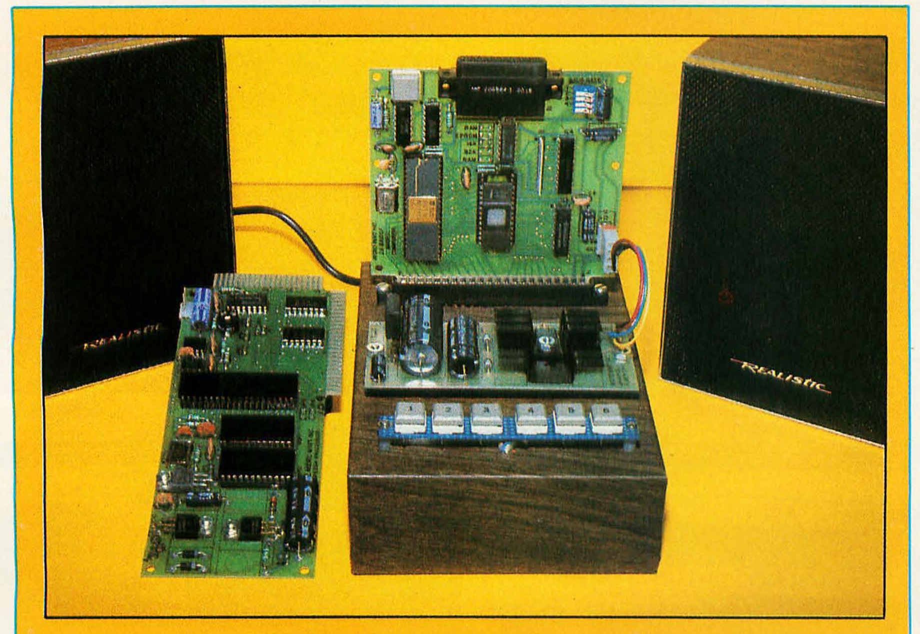


Photo 2: *The Z8/Micromouth demonstrator. A Z8-BASIC Microcomputer is configured to run a ROM-resident program that exercises the Micromouth speech synthesizer presented in the June Circuit Cellar article. A Micromouth board similar to that shown on the left is mounted inside the enclosure. Six pushbutton switches, connected to a parallel input port on the Z8 board, select various speech-demonstration sequences. The Micromouth board is driven from a second parallel port on the Z8 board.*

At a Glance

Name
Z8-BASIC Microcomputer

Processor
Zilog Z8-family Z8671 8-bit microcomputer with programmable (read/write) memory, read-only memory, and I/O in a single package. The Z8671 includes a 2 K-byte tiny-BASIC/Debug resident interpreter in ROM, 144 internal 8-bit registers, and 32 I/O lines. System uses 7.3728 MHz crystal to establish clock rate. Two internal and four external interrupts.

Memory
Uses Z6132 4 K-byte Quasi-Static Memory (pin-compatible with 2716 and 2732 EPROMs); 2 K-byte ROM in Z8671. Memory externally expandable to 62 K bytes of program memory and 62 K bytes of data memory.

Input/Output
Serial port: RS-232C-compatible and switch-selectable to 110, 150, 300, 1200, 2400, 4800, and 9600 bps.
Parallel I/O: two parallel ports; one dedicated to input, the other bit-programmable as input or output; programmable interrupt and handshaking lines; LSTTL-compatible.
External I/O: 16-bit address and 8-bit bidirectional data bus brought out to expansion connector.

BASIC Keywords
GOTO, GO@, USR, GOSUB, IF...THEN, INPUT, LET, LIST, NEW, REM, RETURN, RUN, STOP, IN, PRINT, PRINT HEX. Integer arithmetic/logic operators: +, −, /, *, and AND; BASIC can call machine-language subroutines for increased execution speed; allows complete memory and register interrogation and modification.

Power-Supply Requirements
+5 V ±5% at 250 mA
+12 V ±10% at 30 mA
−12 V ±10% at 30 mA
(The 12 V supplies are required only for RS-232C operation.)

Dimensions and Connections
4- by 4½-inch board; dual 22-pin (0.156-inch) edge connector. 25-pin RS-232C female D-subminiature (DB-25S) connector; 4-pole DIP-switch data-rate selector.

Operating Conditions
Temperature: 0 to 50°C (32 to 122°F)
Humidity: 10 to 90% relative humidity (noncondensing)

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in a BASIC interpreter are not easily persuaded to give away its secrets.

In most cases, however, a user merely wants to know the location of the GOSUB...RETURN address stack or the format and location of stored program variables. While the source code for BASIC/Debug is also not available (because the object code is mask-programmed into the ROM, you couldn't change it anyway), the locations of all variables, pointers, stacks, etc, are fixed, and their storage formats are defined and described in detail. The 60-page BASIC/Debug user's manual contains this information and is included in the 200 pages of documentation supplied with the Z8-BASIC Microcomputer board. (The documentation is also available separately.)

Address	Contents
FFFF	
FFFD	—— Data-rate switches
	Remainder undefined
C000	
BFFF	
	User-memory and I/O-expansion area
8000	
7FFF	
	undefined
2000	
17FF	
	On-board 4 K bytes of read/write memory or EPROM
800	
7FF	
	BASIC/Debug ROM
100	
FF	
	Z8 registers
00	

Figure 1: *A simplified hexadecimal memory map of the Z8-BASIC Microcomputer.*

Memory Allocation

Z8-family microcomputers distinguish between four kinds of memory: internal registers, internal ROM, external ROM, and external read/write memory. (A slightly different distinction can also be made between program memory and data memory, but in this project this distinction is unnecessary.) The register file resides in memory-address space in hexadecimal locations 0 through FF (decimal 0 through 255). The 144 registers include four I/O- (input/output) port registers, 124 general-purpose registers, and 16 status and control registers. (No registers are implemented in hexadecimal addresses 80 through EF [decimal addresses 128 through 239]).

The 2 K-byte ROM on the Z8671 chip contains the BASIC/Debug interpreter, residing in address space from address 0 to hexadecimal 7FF (decimal 0 to 2047). External memory starts at hexadecimal address 800 (decimal 2048). A memory map of the Z8-BASIC Microcomputer system is shown in figure 1.

When the system is first turned on, BASIC/Debug determines how much external read/write memory is available, initializes memory pointers, and checks for the existence of an autostart-up program. In a system with external read/write memory, the top page is used for the line buffer, program-variable storage, and the GOSUB...RETURN address stack. Program execution begins at hexadecimal location 800 (decimal 2048).

When BASIC/Debug finds no external read/write memory, the internal registers are used to store the variables, line buffer, and GOSUB...RETURN stack. This limits the depth of the stack and the number of variables that can be used simultaneously, but the restriction is not too severe in most control applications. In a system without external memory, automatic program execution begins at hexadecimal location 1020 (decimal 4128).

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In a system that uses an external 2 K-byte EPROM (type 2716), wraparound addressing occurs, because the state of the twelfth address line on the address bus (A11) is ignored. (A 4 K-byte type-2732 EPROM device does use A11.) A 2716 EPROM device inserted in the Z6132's memory socket will read from the same memory cells in response to accesses to both logical hexadecimal addresses 800 and 1000. Similarly, hexadecimal addresses 820 and 1020 will be treated as equivalent by the 2716 EPROM. Therefore, when a 2 K-byte 2716 EPROM is being used, the auto-start address, normally operating at hexadecimal 1020, will begin execution of any program beginning at hexadecimal location 820. For the purposes of this discussion, you may assume that programs stored in EPROM use type-2716 devices and that references to hexadecimal address 820 also apply to hexadecimal address 1020.

Listing 1: *Simple illustration of BASIC program storage in the Z8-BASIC Microcomputer.*

```
        100       P    R    I    N    T    "    T
800     00   64   50   52   49   4E   54   20   22   54
        E    S    T    "
80A     45   53   54   22   00   FF   FF
```

Listing 2: *A multiple-line illustration of BASIC program storage.*

```
100 A=5
200 B=6
3005 "A*B=";A*B
```

```
        100       A    =    5         200       B    =
800     00   64   41   3D   35   00   00   C8   42   3D
        6         3005      "    A    *    B    =    "
80A     36   00   0B   BD   22   41   2A   42   3D   22
        ;    A    *    B
814     3B   41   2A   42   00   FF   FF
```

Program Storage

The program-storage format for BASIC/Debug programs is the same in both types of memory. Each BASIC statement begins with a line number and ends with a delimiter. If you were to connect a video terminal or teletypewriter to the RS-232C serial port and type the following line:

100 PRINT "TEST"

it would be stored in memory beginning at hexadecimal location 800 as shown in listing 1.

The first 2 bytes of any BASIC statement contain the binary equivalent of the line number (100 decimal equals 64 hexadecimal). Next are bytes containing the ASCII (American Standard Code for Information Interchange) values of characters in the statement, followed by a delimiter byte (containing 00) which indicates the end of the line. The last statement in the program (in this case the only one) is followed by 2 bytes containing the hexadecimal value FFFF, which designates line number 65535.

The multiple-line program in listing 2 further illustrates this storage format.

One final example of this is illustrated in listing 3 on page 58. Here is a program written to examine itself. Essentially, it is a memory-dump routine which lists the contents of memory in hexadecimal. As shown, the 15-line program takes 355 bytes and occupies hexadecimal locations 800 through 963 (decimal 2048 through 2499). I have dumped the first and last lines of the program to further demonstrate the storage technique.

I have a reason for explaining the internal program format. One of the useful features of this computer is its ability to function with programs residing solely in EPROM. However,



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the EPROMs must be programmed externally. While I will explain how to serially transmit the contents of the program memory to an EPROM programmer, some of you may have only a manual EPROM programmer or one with no communication facility. But if you are willing to spend the time, it is easy to print out the contents of memory and manually load the program into an EPROM device.

Dedicated-Controller Use

The Z8-BASIC Microcomputer can be easily set up for use in intelligent control applications. After being tested and debugged using a terminal, the control program can be written into an EPROM. When power is applied to the microcomputer, execution of the program will begin automatically.

The first application I had for the unit was as a demonstration driver for the Micromouth speech-processor board I presented two months ago in the June issue of BYTE. (See "Build a Low-Cost Speech-Synthesizer Interface," in the June 1981 BYTE, page 46, for a description of this project, which uses National Semiconductor's Digitalker chip set.) It's hard to discuss a synthesized-speech interface without demonstrating it, and I didn't want to carry around my big computer system to control the Micromouth board during the demonstration. Instead, I quickly programmed a Z8-BASIC Microcomputer to perform that task. While I was at it, I set it up to demonstrate itself as well.

The result (see photo 2 on page 52) has three basic functional components. On top of the box is a Z8-BASIC Microcomputer (hereinafter called the "Z8 board") with a 2716 EPROM installed in the memory integrated-circuit socket, the Z8-board power supply (the wall-plug transformer module is out of view), and six pushbutton switches. Inside the box is a prototype version of the Micromouth speech-processor board (a final-version Micromouth board is shown on the left).

The Micromouth board is jumper-programmed for parallel-port operation (8 parallel bits of data and a data-ready strobe signal) and connected to I/O port 2 on the Z8 board. The Micromouth BUSY line and the six pushbuttons are attached to 7 input bits of the Z8 board's input port mapped into memory-address space at hexadecimal address FFFD (decimal 65533).

The most significant 3 bits of port FFFD are normally reserved for the data-rate-selector switches, but with no serial communication required, the data rate is immaterial and the switches are left in the open position. This makes the 8 bits of port FFFD, which are brought out to the edge

Listing 3: *A program (listing 3a) that examines itself by dumping the contents of memory in printed hexadecimal form. Listing 3b shows the first and last lines of the program as dumped during execution.*

(3a)

```
100 PRINT"ENTER START ADDRESS FOR HEX DUMP ";:INPUT X
102 PRINT"THE LIST IS HOW MANY BYTES LONG ";:INPUT C
103 PRINT:PRINT
105 B=X+8 :A=X+C
107 PRINT"ADDRESS                    DATA":PRINT
110 PRINT HEX (X);"         ";
120 GOSUB 300
130 X=X+1
140 IF X=B THEN GOTO 180
150 GOTO 120
180 IF X>=A THEN 250
200 PRINT:PRINT:B=X+8:GOTO 110
250 PRINT:STOP
300 PRINT HEX (@X);: PRINT"  ";
310 RETURN
:
```

(3b)

```
:RUN
ENTER START ADDRESS FOR HEX DUMP ? 2048
THE LIST IS HOW MANY BYTES LONG ? 30

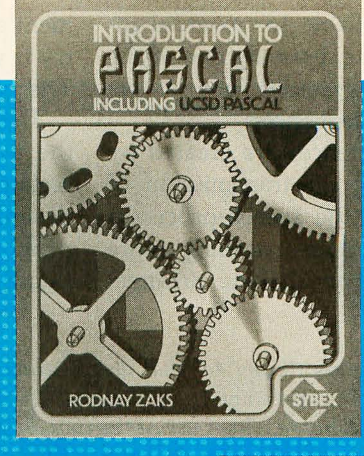
ADDRESS          DATA

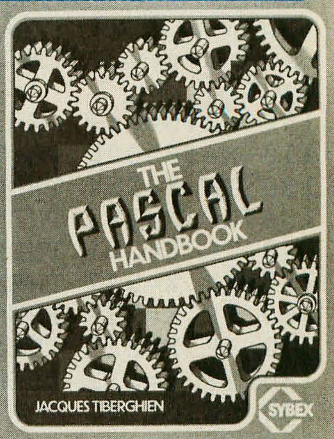
               100      P     R     I     N     T     "
800       0     64     50    52    49    4E    54    22
          E      N      T     E     R    sp     S     T
808      45     4E     54    45    52    20    53    54
          A      R      T    sp     A     D     D     R
810      41     52     54    20    41    44    44    52
          E      S      S    sp     F     O     R    sp
818      45     53     53    20    46    4F    52    20
:
:
:RUN
ENTER START ADDRESS FOR HEX DUMP ? 2360
THE LIST IS HOW MANY BYTES LONG ? 45

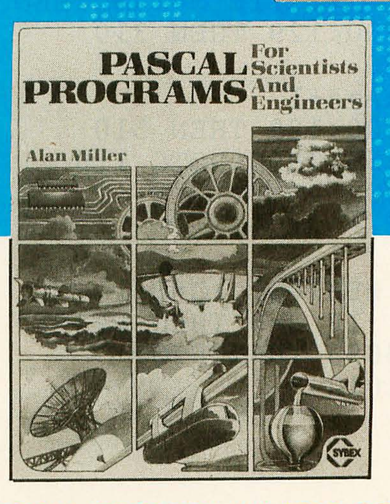

ADDRESS          DATA
          O      P             300        P     R     I
938      4F     50      0     1    2C    50    52    49
          N      T     sp     H     E     X    sp     (
940      4E     54     20    48    45    58    20    28
          @      X      )     ;     :    sp     P     R
948      40     58     29    3B    3A    20    50    52
          I      N      T     "    sp    sp     "     ;
950      49     4E     54    22    20    20    22    3B
                  310         R     E     T     U     R
958       0      1     36    52    45    54    55    52
          N            65535
960      4E      0     FF    FF     0     0     0     0
```


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connector, available for external inputs. In this case, pressing one of the six pushbuttons selects one of six canned speech sequences.

Coherent sentences are created by properly timing the transmission of word codes to the speech-processor board. This requires nothing more than a single handshaking arrangement and a table-lookup routine (but try it without a computer sometime). The program is shown in listing 4a.

The first thing to do is to configure the port-2 and port-3 mode-control registers (hexadecimal F6 and F7, or decimal 246 and 247). Port 2 is bit-programmable. For instance, to configure it for 4 bits input and 4 bits output, you would load F0 into register F6 (246). In this case, I wanted it configured as 8 output bits, so I typed in the BASIC/Debug command @246=0 (set decimal location 246 to 0).

The data-ready strobe is produced using one of the options on the Z8's port 3. A Z8 microcomputer has data-available and input-ready handshaking on each of its 4 ports. To set the proper handshaking protocol and use port 2 as I have described, a code of hexadecimal 71 (decimal 113) is placed into the port-2 mode-control register. The BASIC/Debug command is @247= 113. The RDY2 and $\overline{\text{DAV2}}$ lines on the Z8671 are connected together to produce the data-available strobe signal.

Lines 1000 through 1030 in listing 4a have nothing to do with demonstrating the Micromouth board. They form a memory-dump routine that illustrates how the program is stored in memory. You notice from the memory dump of listing 4b that the first byte of the program, as stored in the ROM, begins at hexadecimal location 820 (actually at 1020, you remember) rather than 800 as usual. This is to help automatic start-up. The program could actually begin anyplace, but you would have to change the program-pointer registers (registers 8 and 9) to reflect the new address. The 32 bytes between 800 and 820 are reserved for vectored addresses to optional user-supplied I/O drivers and interrupt routines.

Listing 4: *A program (listing 4a) that demonstrates the functions of the Micromouth speech synthesizer, operating from a type-2716 EPROM. The simple I/O-address decoding of the Z8 board allows use of the round-figure address of 65000. The program uses a table of vocabulary pointers that has been previously stored in the EPROM by hand. Listing 4b shows a dump of the memory region occupied by the program, proving that storage of the BASIC source code starts at hexadecimal location 820.*

(4a)

```
100 @246=0:@247=113
110 X=@65000 :A=%1400
120 IF X=254 THEN @2=0
130 IF X=253 THEN GOTO 500
140 IF X=251 THEN A=A+32 :GOTO 500
150 IF X=247 THEN A=A+64 :GOTO 500
160 IF X=239 THEN A=A+96 :GOTO 500
170 IF X=223 THEN A=A+128 :GOTO 500
180 IF X=222 THEN N=0 :GOTO  300
200 GOTO 110
300 @2=N :N=N+1 :IF N=143 THEN 110
310 IF @65000<129 THEN 310
320 GOTO 300
500 @2=@A :A=A+1
510 IF @65000<129 THEN 510
520 IF @A=255 THEN GOTO 110
530 GOTO 500
1000 Q=2048
1005 W=0
1010 PRINT HEX(@Q),:Q=Q+1
1015 W=W+1 :IF W=8 THEN PRINT" ":GOTO 1005
1020 IF Q=4095 THEN STOP
1030 GOTO 1010
:
```

(4b)

```
:goto 1000
FF      FF      FF      FF      FF      FF      FF      FF
FF      FF      FF      FF      FF      FF      FF      FF
FF      FF      FF      FF      FF      FF      FF      FF
FF      FF      FF      FF      FF      FF      FF      FF
0       64      40      32      34      36      3D      30
3A      40      32      34      37      3D      31      31
33      0       0       6E      58      3D      40      36
35      30      30      30      20      3A      41      3D
25      31      34      30      30      0       0       78
49      46      20      58      3D      32      35      34
20      54      48      45      4E      20
0! AT 1015
:
```

Programming the EPROM

The first EPROM-based program I ran on the Z8-BASIC Microcomputer was manually loaded. I simply

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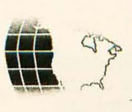
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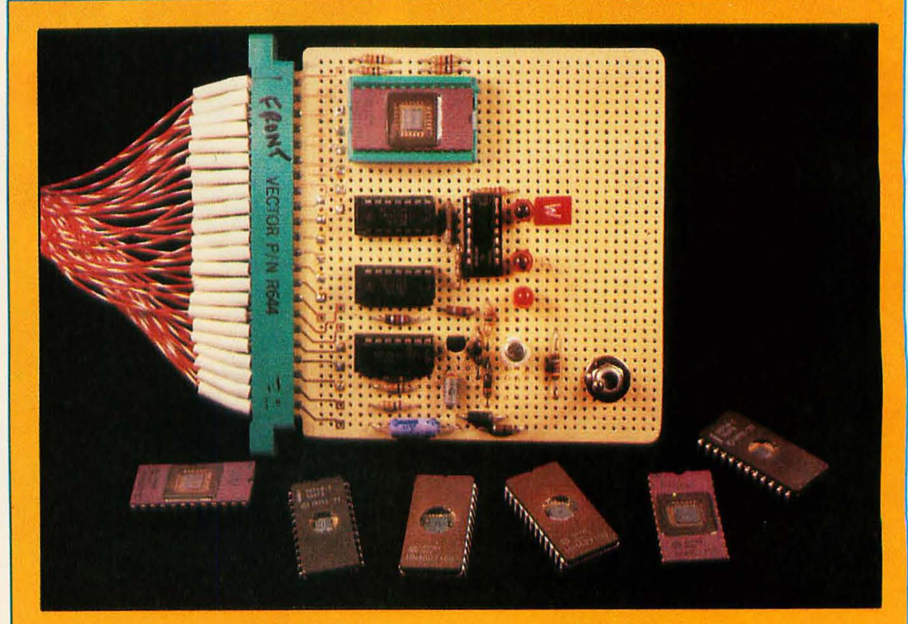


Photo 3: *Type-2716 EPROM programmer, adapted from "Program Your Next EROM in BASIC" (March 1978 BYTE, page 84). The circuit, which is driven through parallel ports, programs a 2716 in about 2½ minutes and is controlled by a BASIC program.*

printed out the contents of the Z6132 memory using the program of listing 3 and entered the values by hand into the EPROM programmer. This is fine once or twice, but you certainly wouldn't want to make a habit of it. Fortunately, there are better alternatives if you have the equipment.

Many EPROM programmers are peripheral devices on larger computer systems. In such cases, it is possible to take advantage of the systems' capabilities by downloading the Z8 program directly to the programmer.

The programmer shown in photo 3 is a revised version of the unit I described in a previous article, "Program Your Next EROM in BASIC" (March 1978 BYTE, page 84). It was designed for type-2708 EPROMs, but I have since modified it to program 2716s instead. All I had to do was lengthen the programming pulse to 50 ms and redefine the connections to four pins on the EPROM socket. It still is controlled by a BASIC program and takes less than 2½ minutes to program a type-2716 EPROM device. Refer to the original article for the basic design.

Normally, the LIST function or memory-dump routine cannot be used to transmit data to the EPROM programmer because the listing is filled with extraneous spaces and carriage returns. It is necessary to write a program that transmits the contents of memory without the extra characters required for display formatting. The only data received by the EPROM programmer should be the object code to load into the EPROM.

In writing this program we can take advantage of the Z8's capability of executing machine-language programs directly through the USR and GO@ commands. The serial-input and serial-output subroutines in the BASIC/Debug ROM can be executed independently using these commands. The serial-input driver starts at hexadecimal location 54, and the serial-output driver starts at hexadecimal location 61. Transmitting a single character is simply done by the BASIC statement

```
GO@ %61,C
```

where C contains the value to be transmitted. A serial character can be received by

```
C=USR (%54)
```

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Listing 5: *BASIC statements that print out the entire contents of the 4 K bytes of user memory, for use with a communicating EPROM programmer.*

```
1000 X=%800 :REM BEGINNING OF
     USER MEMORY
1010 GO@ %61,@X :REM TRANSMIT
     CONTENTS OF LOCATION X
1020 X=X+1 :IF X=%1801 THEN
     STOP
1030 GOTO 1010
```

Listing 6: *A simple BASIC program segment to demonstrate the concept of the "black box" method of modifying data being transmitted through the Z8-BASIC Microcomputer.*

```
100 @246=0:@247=113 :REM SET PORT
    2 TO BE OUTPUT
110 @2=X :REM X EQUALS THE DATA
    TO BE TRANSMITTED
```

where the variable C returns the value of the received data.

To dump the entire contents of the Z6132 memory to the programmer, the statements in listing 5 should be included at the end of your program.

Execution begins when you type GOTO 1000 as an immediate-mode command and ends when all 4 K bytes have been dumped. The transmission rate (110 to 9600 bps) is that selected on the data-rate-selector switches.

Conceivably, this technique could also be used to create a cassette-storage capability for the Z8 board. In theory, a 3- or 4-line BASIC program can be entered in high memory (you can set the pointer to put the program there) to read in serial data and load it in lower memory. Changing the program pointer back to hexadecimal 800 allows the newly loaded program to be executed. Since the Z8-BASIC Microcomputer already has a serial I/O port, any FSK (frequency-shift keyed) modem and cassette-tape recorder can be used for cassette data storage.

I/O for Data Acquisition

Data acquisition for process control is the most likely application for the Z8-BASIC Microcomputer. Low-

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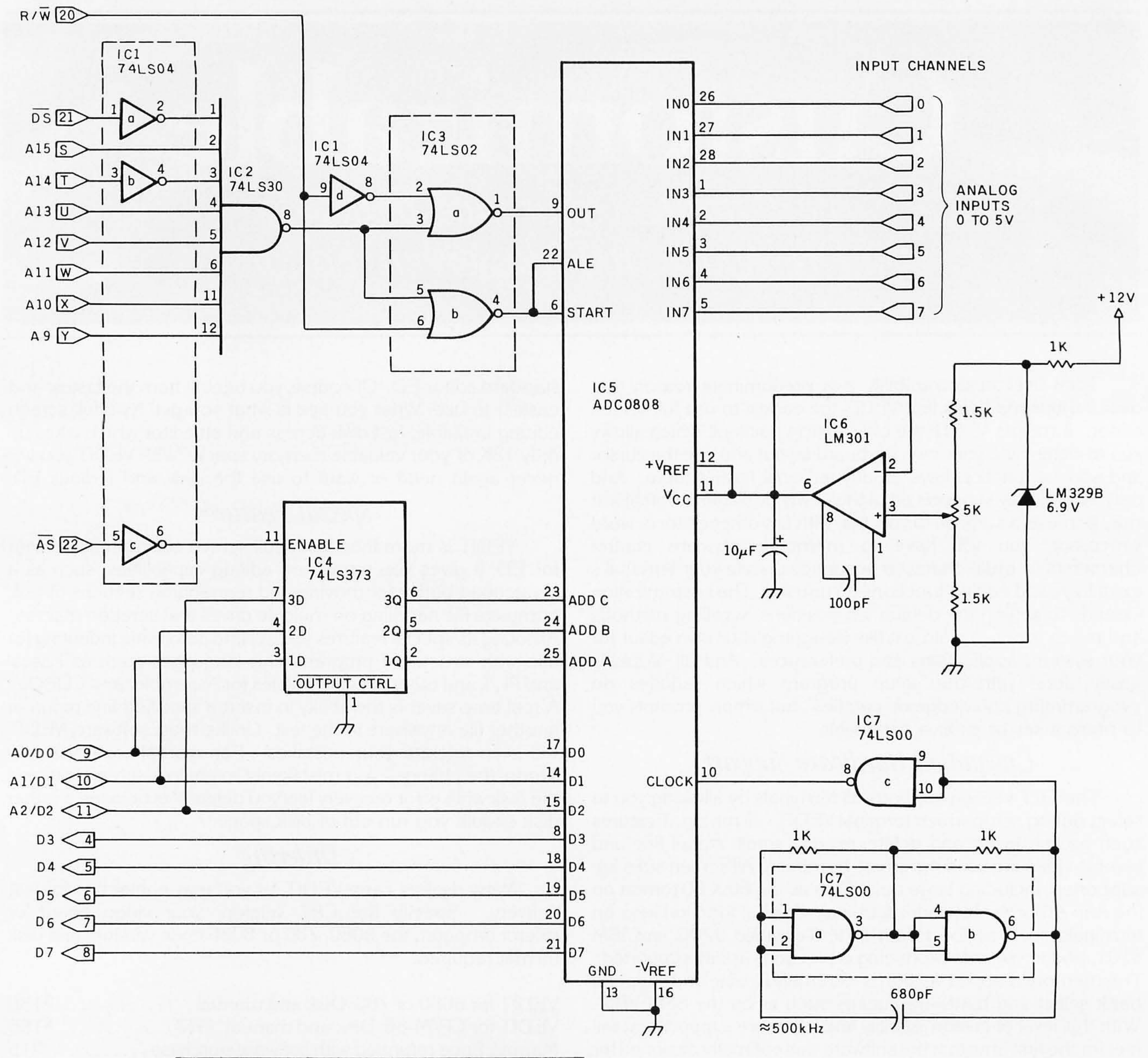
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IC1	74LS04	14	7	
IC2	74LS30	14	7	
IC3	74LS02	14	7	
IC4	74LS373	20	10	
IC5	ADC0808	see schematic diagram		
IC6	LM301		4	7
IC7	74LS00	14	7	

Figure 2: *Schematic diagram of an A/D converter. This 8-bit, eight-channel unit has a unipolar input range of 0 to +5 V, with the eight output channels addressed as I/O ports mapped into memory-address space at hexadecimal addresses BF00 through BF07.*

cost distributed control is practical, substituting for central control performed by a large computer system. Analog and digital sensors can be read by a Z8-BASIC Microcomputer, which then can digest the data and reduce the amount of information (experiment results or control parameters) stored or transmitted to a central point. Control decisions can be made by the Z8-BASIC Microcomputer at the process locality.

The Z8 board can be used for analog data acquisition, perhaps using an A/D (analog-to-digital) converter such as that shown in figure 2. This 8-bit, eight-channel A/D converter has a unipolar input range of 0 to +5 V (although the A/D integrated circuit can be wired for bipolar operation), with the eight output channels addressed as I/O ports mapped into memory-address space at hexadecimal addresses BF00 through BF07 (decimal 48896 through 48903). When the Z8671 performs an output operation to the channel address, the channel is initialized for acquiring data, while data is read from the channel when the Z8671 performs

Number	Type	+5V	GND	−12V	+12V
IC1	COM2017	1	3	2	
IC2	COM5016	2	11		9
IC3	COM1488		7	1	14

Figure 3: *Schematic diagram of an RS-232C serial output port for the "black box" communication application of the Z8-BASIC Microcomputer. The Z8671 must be configured by software to provide the proper signals: one such signal, $\overline{DAV2}$, is derived from two bits of I/O port 3 on the Z8671. The pin numbers shown in the schematic diagram for $P3_1$ and $P3_6$ are pins on the Z8671 device itself, not pins or sections on the card-edge connector, as are $P2_0$ through $P2_7$.*

an input operation on the channel's address.

Intelligent Communication

Another possible use for the Z8-BASIC Microcomputer is as an intelligent "black box" for performing predetermined modification on data being transmitted over a serial communication line. The black box has two DB-25 RS-232C connectors, one for receiving data and the other for retransmitting it. The intelligence of the Z8-BASIC Microcomputer, acting as the black box, can perform practically any type of filtering, condensing, or translating of the data going through.

Perhaps you have an application where continuous raw data is transmitted, but you would rather just keep a running average or flag deviations from preset limits at the central monitoring point rather than contend with everything. The Z8 board can be programmed to digest all the raw data coming down the line and pass



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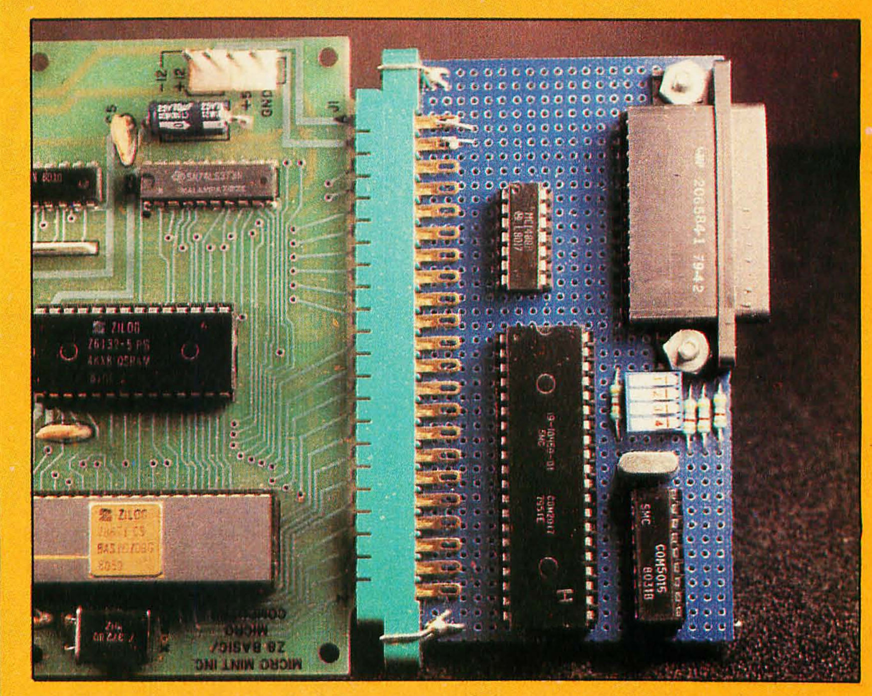


Photo 4: *A three-integrated-circuit hardwired serial output port for the Z8-BASIC Microcomputer. Connected to port 2, any program data sent to register 2 will be transmitted serially at the data rate selected on the four-position DIP switch (between 50 to 19200 bps). The Z8 board, configured with two serial ports, is used to process raw data moving through it. Data is received on one side, digested, and retransmitted in some more meaningful form from the other port. Such a configuration could also be used to connect two peripheral devices that have radically different data rates.*

on only what's pertinent.

Another such black-box application is to use the Z8 board as a printer buffer. Photo 4 shows the interface hardware of one specific application, which I used to attach a high-speed computer to a very slow printer. The host computer transmitted data to the Z8 board at 4800 bps. Since the receiving serial port used had to be bidirectional to handshake with the host computer, I added another serial output to the Z8 board for transmitting characters to the printer. Only three integrated circuits were required to add a serial output port. A schematic diagram is shown in figure 3 on page 67. The UART (universal asynchronous receiver/transmitter, shown as IC1) is driven directly from port 2 on the Z8 board (port 2 could also be used to directly drive a parallel-interface printer), and IC2 supplies the clock signal for the desired data rate. Of course, the UART could have been attached to the data and address buses directly, but this was easier.

Transmitting a character out of this serial port requires setting the port-2 and port-3 mode-control registers as before. After that, any character sent to port 2 will be serially transmitted. The minimum program to perform this is shown in listing 6 on page 64. This circuit can also be used for downloading programs to the EPROM programmer.

In Conclusion

It is impossible to describe the full potential of the Z8-BASIC Microcomputer in so few pages. For this reason, considerable effort has been taken to fully document its characteristics. I have merely tried to given an introduction here.

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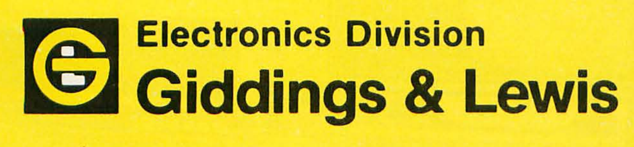
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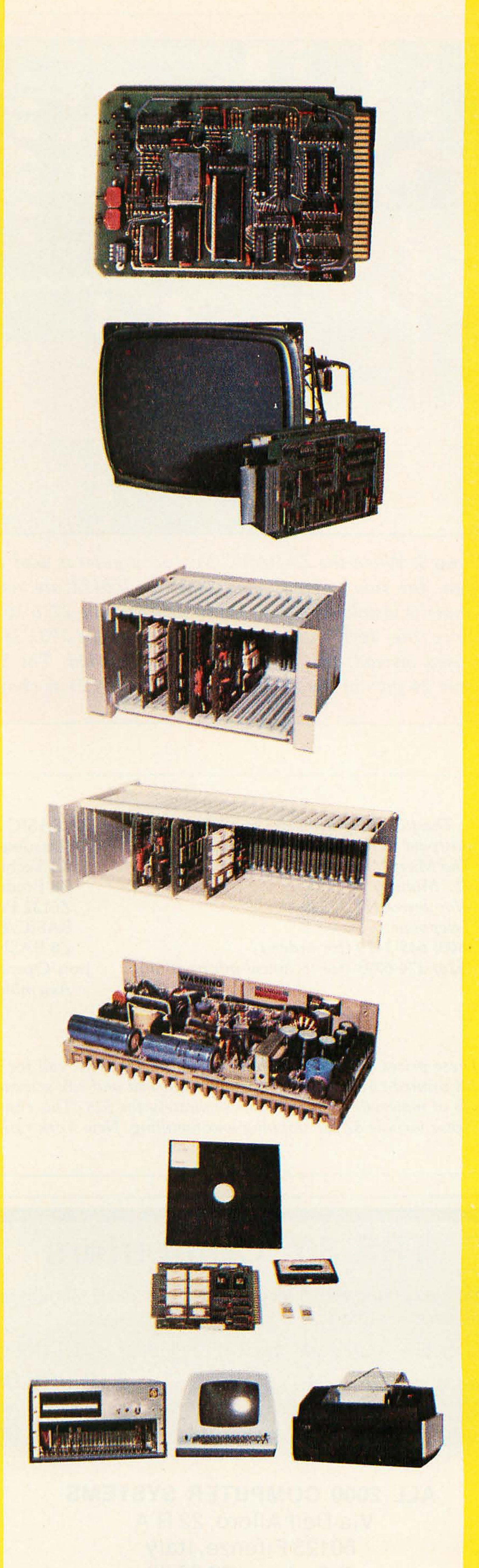
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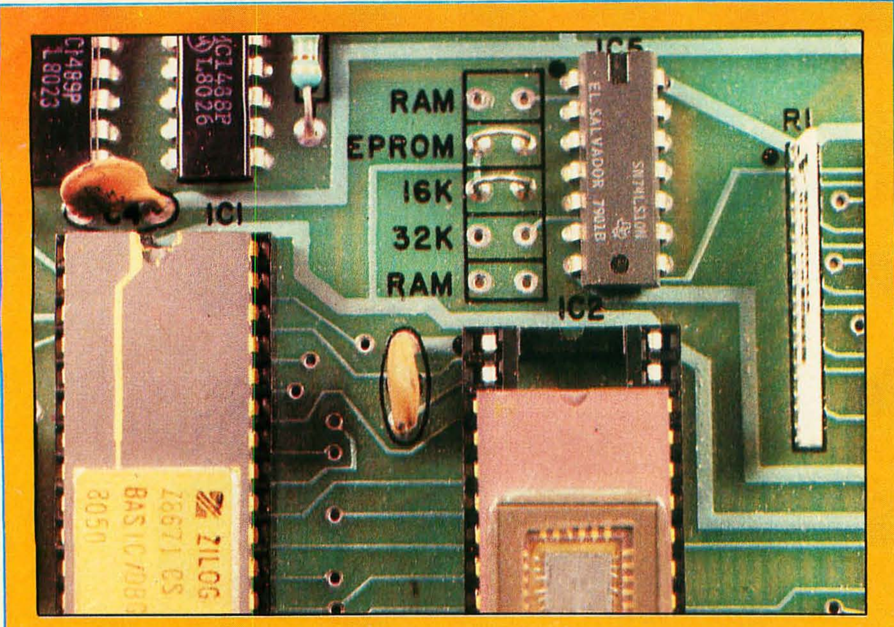


Photo 5: *When the Z8-BASIC Microcomputer is used with a ROM-resident program, the two jumpers used with the Z6132 are removed, and the EPROM jumper is installed instead. When using a type-2716 16 K-bit (2 K-byte) EPROM device, the "16 K" jumper is installed. If a type-2732 32 K-bit (4 K-byte) EPROM is used instead, the "32 K" jumper is installed. The EPROM is inserted in the lower 24 pins of the 28-pin Z6132 socket (IC2) as shown.*

Next Month: *Build a phonetic voice synthesizer based on the Votrax SC-01 synthesizer chip.* ■

Special thanks to Steve Walters and Peter Brown of Zilog Inc for their aid in producing these articles.

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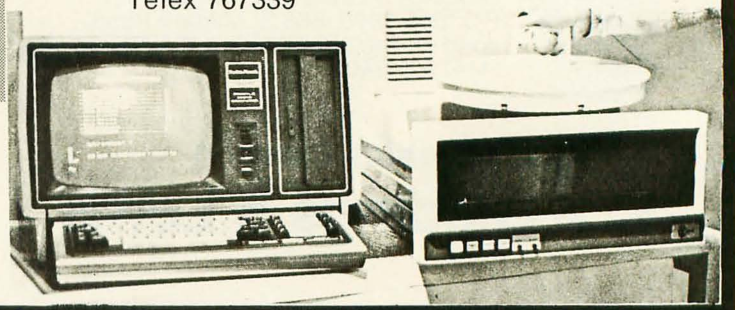
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Object-Oriented Software Systems

David Robson
Learning Research Group
Xerox Palo Alto Research Center
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Palo Alto CA 94304

This article describes a general class of tools for manipulating information called object-oriented software systems. It defines a series of terms, including software system *and* object-oriented. *The description is greatly influenced by a series of object-oriented programming environments developed in the last ten years by the Learning Research Group of Xerox's Palo Alto Research Center, the latest being the Smalltalk-80 system. The article describes object-oriented software systems in general, instead of the Smalltalk-80 system in particular, in order to focus attention on the fundamental property that sets the Smalltalk-80 system apart from most other programming environments. The words "object-oriented" mean different things to different people. Although the definition given in this article may exclude systems that should rightfully be called object-oriented, it is a useful abstraction of the idea behind many software systems.*

Many people who have no idea how a computer works find the idea of object-oriented systems quite natural. In contrast, many people who have experience with computers initially think there is something strange about object-oriented systems. (I don't mean to imply that computer-naive users can create complex systems in an object-oriented environment more easily than experienced programmers can. Creating complex systems involves many techniques more familiar to the programmer than the novice, regardless of whether or not an object-oriented environment is used. But the basic idea about how to create a software system in an object-oriented fashion comes more naturally to those without a preconception about the nature of software systems.) I had had some programming experience when I first encountered an object-oriented system and the idea certainly seemed strange to me. I am assuming that most of you also have some experience with software systems and their creation. So instead of introducing the object-oriented point of view as if it were completely natural, I'll try to explain what makes it seem strange compared to the point of view found in other programming systems.

Software Systems

A software system is a tool for manipulating information. For the purposes of this article, I'm using a very broad definition of information.

> **Information:** *A representation or description of something.*

There are many types of information that describe different things in different ways. One of the great insights in computer science was the fact that information can (among other things) describe the manipulation of information. This type of information is called *software.*

> **Software:** *Information describing the manipulation of information.*

Software has the interesting recursive property of describing how to manipulate things like itself. Software is used to describe a particular type of information-manipulation tool called a *software system.*

> **Software system:** *An information-manipulation tool in which the manipulation is described by software.*

A distinction is made in information-manipulation tools between *hardware* systems and *software* systems. A hardware system is a physical device like a typewriter, pen, copier, or television set. The type of manipulation performed by a hardware system is built in and can only be changed by physical modification. The type of manipulation performed by a software system is not built in—it is determined by information, which can be manipulated.

The virtue of software systems is that the mechanism developed for manipulating information can be used to manipulate the mechanism itself. Software systems that actually manipulate other software systems are called *programming environments.*

> **Programming environment:** *A software system that manipulates software systems. An environment for the design, production, and use of software systems.*

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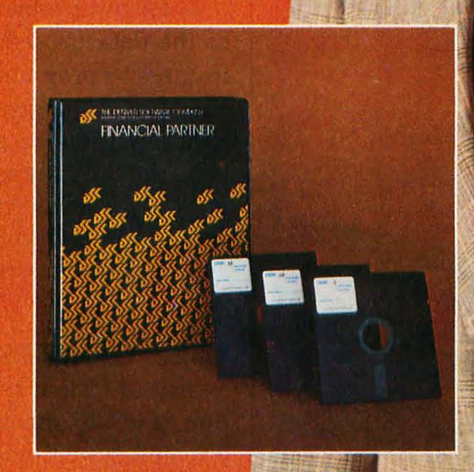
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Thus, a programming environment is also recursive: it *is* what it manipulates. The fact that software systems can be manipulated is both good news and bad news. Since a text editor is a software system, it is not "cast in concrete" and you can change it to conform to your style of interacting with text more closely than it does now (using a programming environment). However, you also may reduce it to the proverbial "pile of bits" (not a text editor at all).

Data/Procedure-Oriented Software

The traditional view of software systems is that they are composed of a collection of *data* that represents some information and a set of *procedures* that manipulates the data.

> **Data:** *The information manipulated by software.*
>
> **Procedure:** *A unit of software.*

Things happen in the system by invoking a procedure and giving it some data to manipulate.

As an example of a software system, consider a system for managing windows that occupy rectangular areas on a display screen. The windows contain text and have titles. They can be moved around the screen, sometimes overlapping each other. (The details of this system are not important. Its main purpose is to point out the differences between the structure of a data/procedure system and an object-oriented system.)

A window-management system implemented as a data/procedure system would include data representing the location, size, text contents, and title of each window on the screen. It would also include procedures that move a window, create a window, tell whether a window overlaps another window, replace the text or title of a window, and perform other manipulations of windows on a display. To move a window, a programmer would call the procedure that moves windows and pass to it the data representing the window and its new location.

A problem with the data/procedure point of view is that data and procedures are treated as if they were independent when, in fact, they are not. All procedures make assumptions about the form of the data they manipulate. The procedure to move a window should be presented with data representing a window to be moved and its new location. If the procedure were presented with data representing the text contents of a window, the system would behave strangely.

In a properly functioning system, the appropriate choice of procedure and data is always made. However, in an improperly functioning system (eg: one in the process of being developed or encountering an untested situation), the data being manipulated by a procedure may be of an entirely different form from that expected. Even in a properly functioning system, the choice of the appropriate procedure and data must always be made by the programmer.

These two problems have been addressed in the context of the data/procedure point of view by adding several features to programming systems. Data typing has been added to languages to let the programmer know that the appropriate choice of data has been made for a particular procedure. In a typed system, the programmer is notified when a procedure call is written using the wrong type of data. Variant records allow the system to choose the appropriate procedure and data in some situations.

Object-Oriented Software

Instead of two types of entity that represent information and its manipulation independently, an object-oriented system has a single type of entity, the *object*, that represents both. Like pieces of data, objects can be manipulated. However, like procedures, objects describe manipulation as well. Information is manipulated by sending a *message* to the object representing the information.

> **Object:** *A package of information* and *descriptions of its manipulation.*
>
> **Message:** *A specification of one of an object's manipulations.*

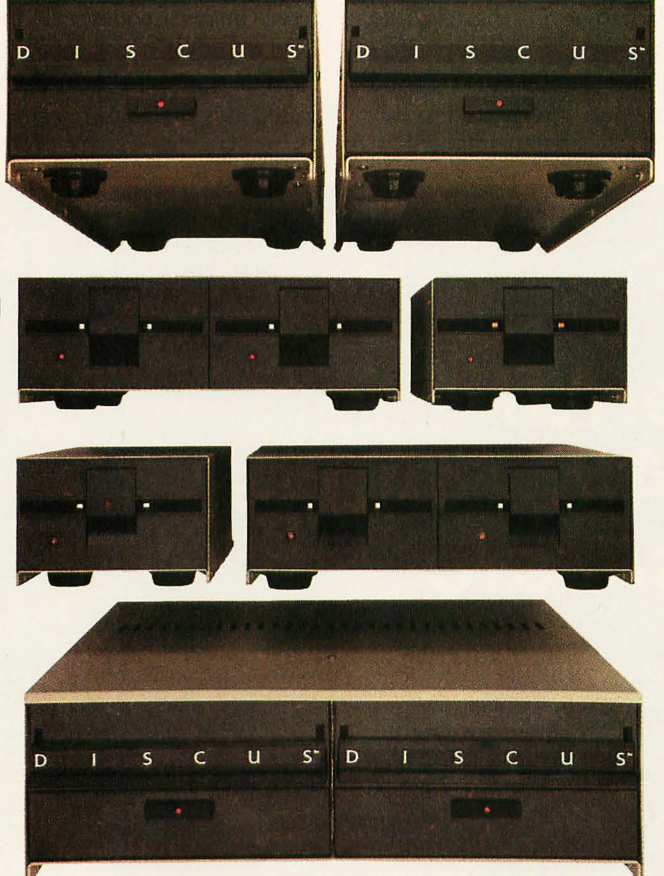
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to manipulate itself. The object to be manipulated is called the *receiver* of the message. A message includes a symbolic name that describes the type of manipulation desired. This name is called the message *selector*. The crucial feature of messages is that the selector is only a *name* for the desired manipulation; it describes *what* the programmer wants to happen, not *how* it should happen. The message receiver contains the description of how the actual manipulation should be performed. The programmer of an object-oriented system sends a message to invoke a manipulation, instead of calling a procedure. A message names the manipulation; a procedure describes the details of the manipulation.

Of course, procedures have names as well, and their names are used in procedure calls. However, there is only one procedure for a name, so a procedure name specifies the exact procedure to be called and exactly what should happen. A message, however, may be interpreted in different ways by different receivers. So, a message does not determine exactly what will happen; the receiver of the message does.

If the earlier example of the window-management system were implemented as an object-oriented system, it would contain a set of objects representing windows. Each object would describe a window on the screen. Each object would also describe the manipulations of the window it represents—for example, how to move it, how to determine whether it overlaps another window, or how to display it. Each of these manipulations would correspond to a selector of a message. The selectors could include move, overlap, display, delete, width, or height. (In this article, an alternate typeface is used for words that refer to specific elements in example systems.)

In addition to a selector, a message may contain other objects that take part in the manipulation. These are called the message *arguments*. For example, to move a

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window, the programmer might send the object representing the window a message with the selector move. The message would also contain an argument representing the new location. Since this is an object-oriented system, the selector and argument are objects: the selector representing a symbolic name and the argument representing a location or point.

The description of a single type of manipulation of an object's information (the response to a single type of message) is a procedure-like entity called a *method*. A method, like a procedure, is the description of a sequence of actions to be performed by a processor. However, unlike a procedure, a method cannot directly call another method. Instead, it must send a message. *The important thing is that methods cannot be separated from objects.* When a message is sent, the receiver determines the method to execute on the basis of the message selector. A different kind of window could be added to the system with a different representation and different methods to respond to the messages move, overlap, display, delete, width, and height. Places where messages are sent to windows do not have to be changed in order to refer to the new kind of window; whichever window receives the message will use the method appropriate to its representation.

Objects look different from the outside than they do from the inside. By the outside of an object, I mean what it looks like to other objects with which it interacts (eg: what rectangles look like to other rectangles or to windows). From the outside, you can only ask an object to do something (send it a message). By the inside of an object, I mean what it looks like to the programmer implementing its behavior. From the inside, you can tell an object how to do something (in a method). For example, a window can respond to messages having the selectors move, overlap, display, delete, width, or height.





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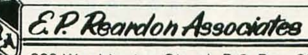
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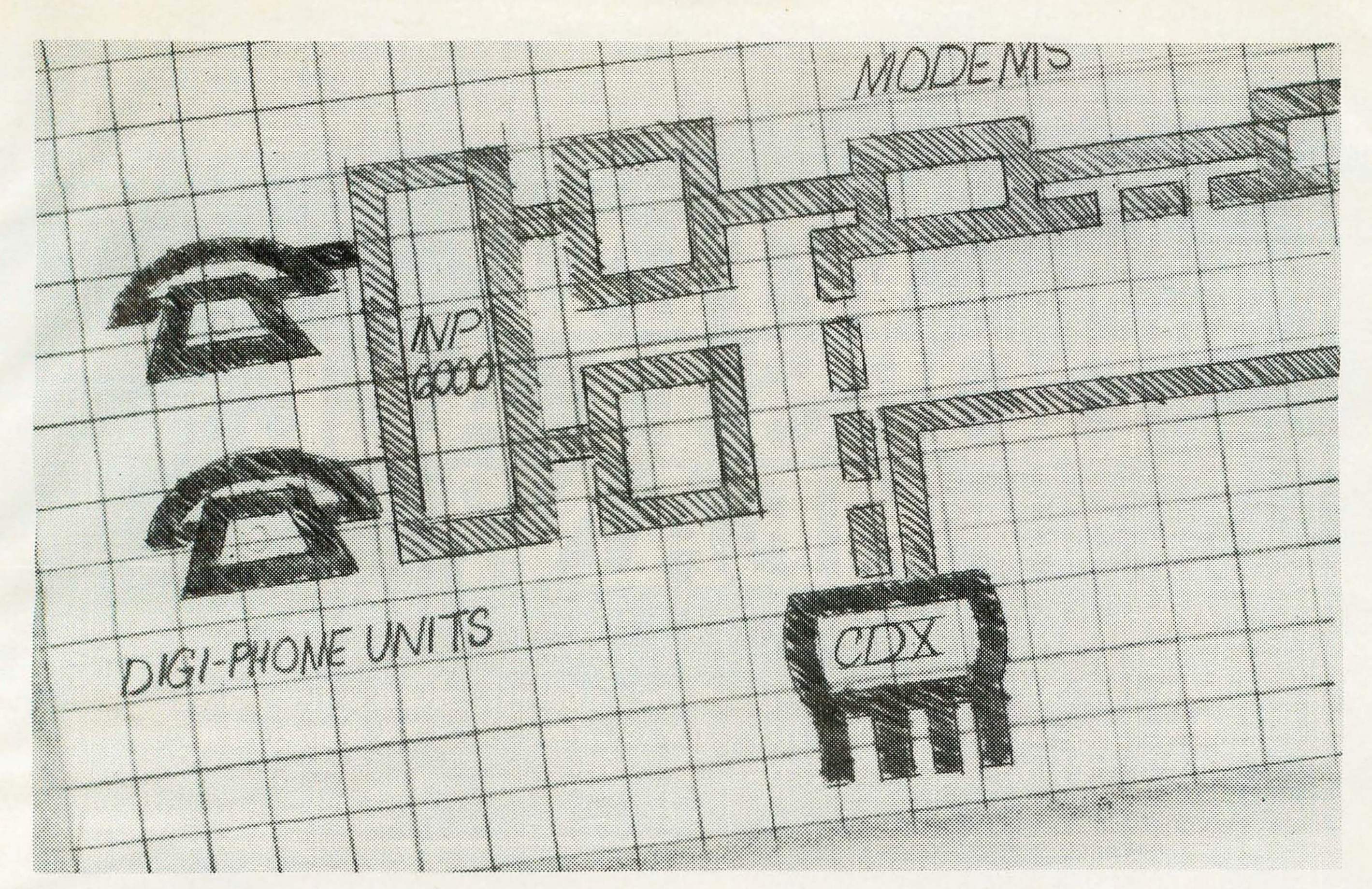
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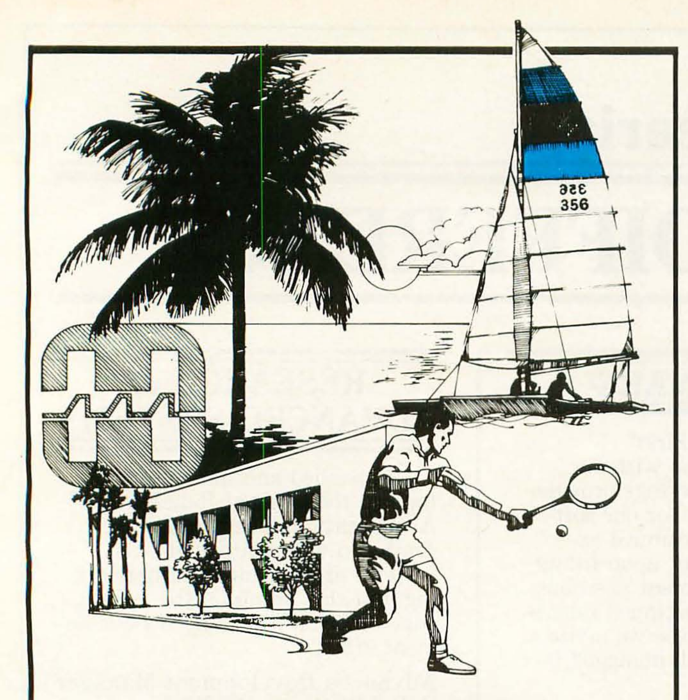
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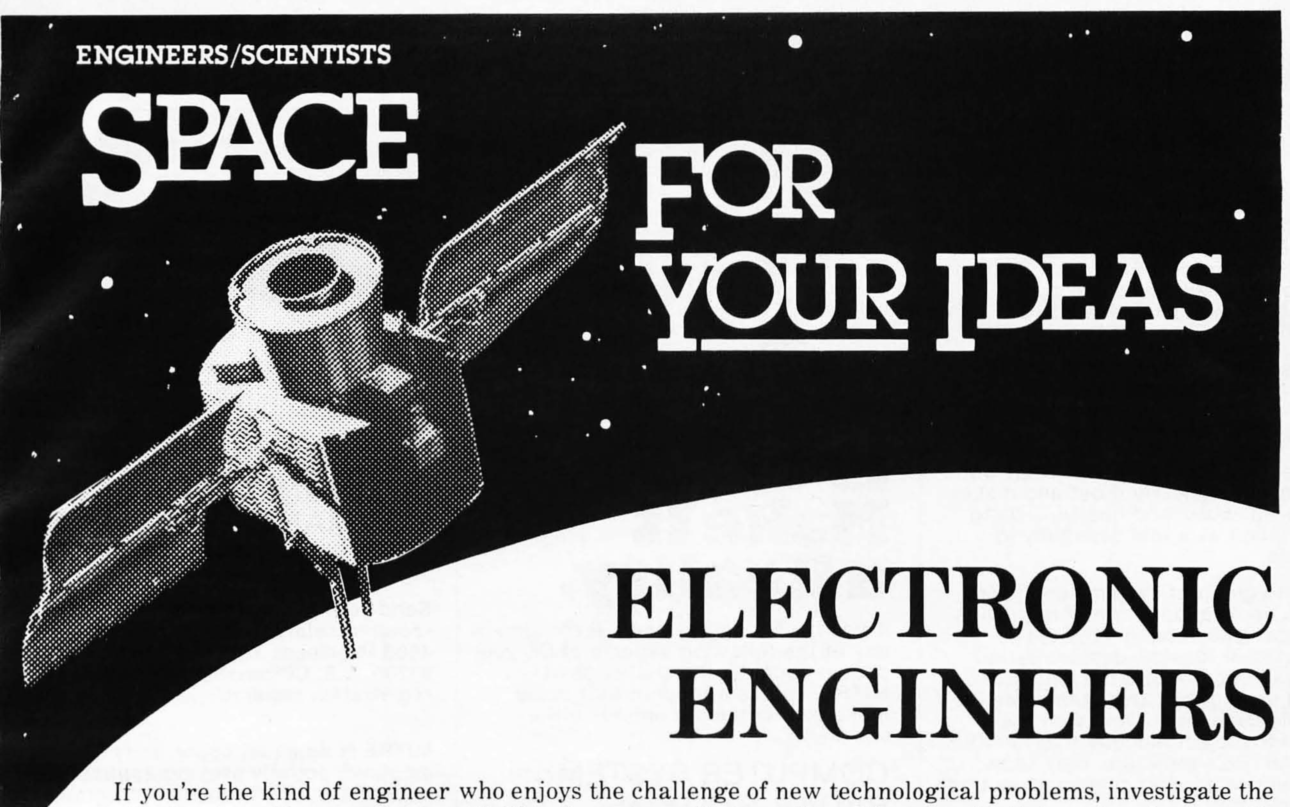
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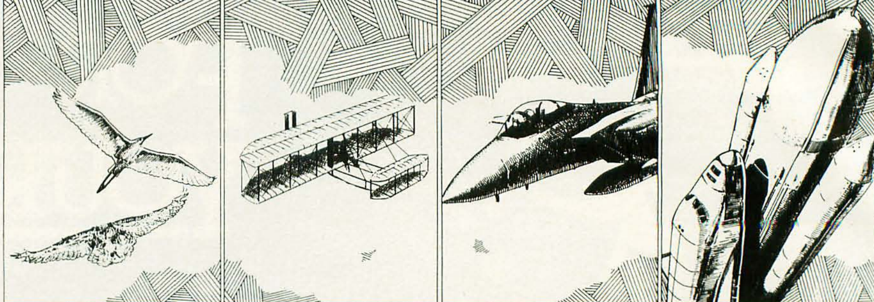
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This is a great simplification of our work in C³ (Command, Control and Communications), but essentially it comes down to these basics:

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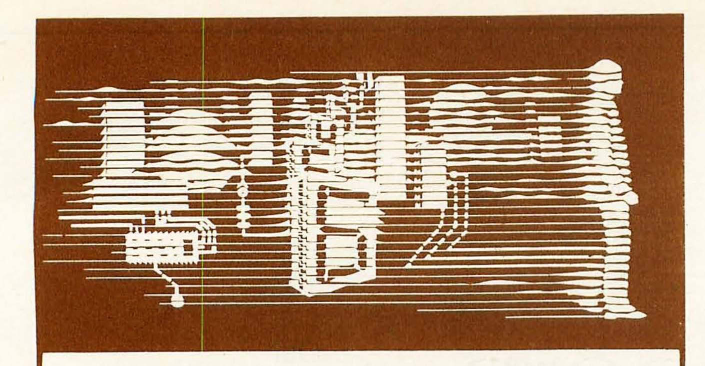
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Our proven C^3 expertise has been dramatically illustrated in such state-of-the-art, long-term programs as the MX and Minuteman. In addition, our Power Systems Organization is recognized as a leader in the design, development and manufacture of high energy Lithium Battery power sources. Right now, we're continuing our successful mode as we actively pursue new and more advanced programs in the C^3 and power systems industries.

Perhaps another consideration that has given SSD an edge is our advantageous location. Here, in Eastern Massachusetts, GTE professionals enjoy the cultural and educational riches of this prized New England environment, the intellectual stimulation of our famed Route 128 electronics belt and the recreational advantages of our distinctive seasons so enhanced by easy access to winters in New Hampshire and Vermont and spectacular summers on the sandy beaches of Cape Cod. All this in an area that claims the extraordinary benefits of easily affordable homes, both in suburban and rural areas.

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- ☐ Telephone Switching
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We will contact you.

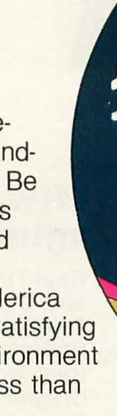
Simply check off the area(s) of interest, complete the following information and forward this page to Bill U. Ahalt, GTE's Sylvania Systems Group, Strategic Systems Division, 189 "B" Street, Needham, MA 02194.

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Circle 251 on inquiry card.

However, nothing is known outside the window about how it responds to these messages. (It is known that a window will move when asked to, but it is not known how it accomplishes the move.)

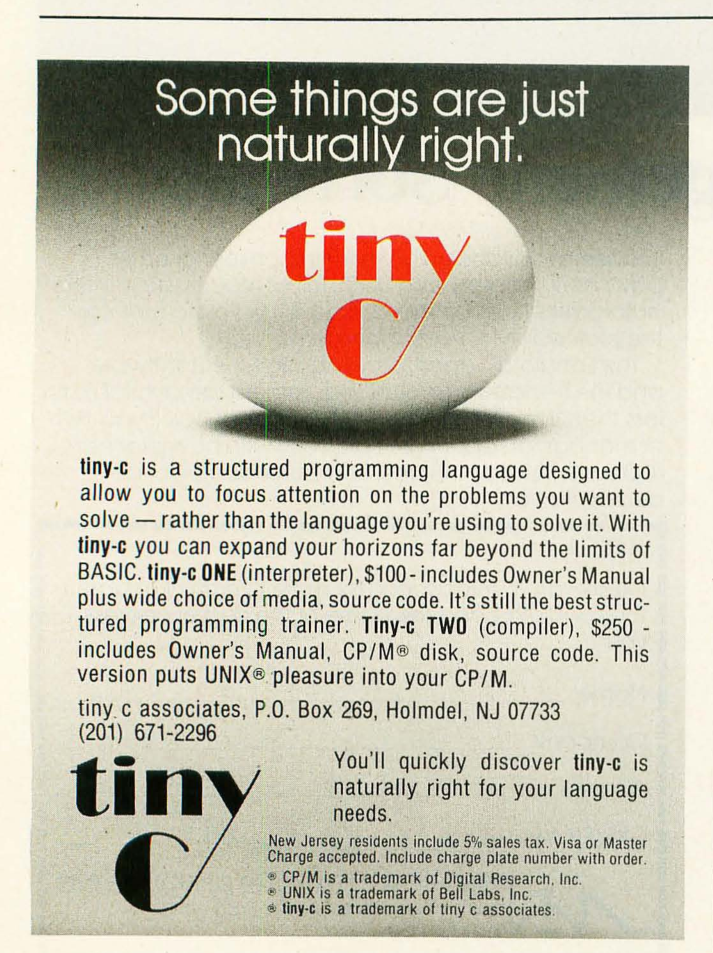
The set of messages an object can respond to is called its *protocol*. The external view of an object is nothing more than its protocol; the internal view of an object is something like a data/procedure system. An object has a set of variables that refers to other objects. These are called its *private variables*. It also has a set of methods that describes what to do when a message is received. The values of the private variables play the role of data and the methods play the role of procedures. This distinction between data and procedures is strictly localized to the inside of the object.

Methods, like other procedures, must know about the form of the data they directly manipulate. Part of the data a method can manipulate are the values of its object's private variables. For example, we might imagine three ways that a window represents its location and size (internally). The private variables might contain:

- four numbers representing the *x* and *y* location of the center, the width, and the height
- two points representing opposite corners of the window
- a single rectangle whose location and size are the same as the window's

The method that moves a window (the response to messages with the selector move) assumes that a particular representation is used. If the representation were changed, the method would also have to be changed. Only the methods in the object whose representation changed need be changed. All other methods must manipulate the window by sending it messages.

A message must be sent to an object to find out anything about it (ie: our concept of manipulation includes inquiring about information, as well as changing information). This is needed because we don't want the form of an object's inside known outside of it. The response to a message may return a value. For example, a window's response to the message width returns an object that represents its width on the display (a number). The method for determining what to return depends on the form of the window's private variables. If they are represented as the first alternative listed above (four numbers), the response would simply return the value of the appropriate private variable. If the second alternative is used (two points), the method would have to determine the width from the *x* coordinates of the two corners. If the third alternative is used (one rectangle), the width message would simply be passed on to the rectangle and the rectangle's response would become the window's response.



Circle 385 on inquiry card.

Classes and Instances

Most object-oriented systems make a distinction between the description of an object and the object itself. Many similar objects can be described by the same general description. The description of an object is called a *class* since the class can describe a whole set of related objects. Each object described by a class is called an *instance* of that class.

> **Class:** *A description of one or more similar objects.*
>
> **Instance:** *An object described by a particular class.*

Every object is an instance of a class. The class describes all the similarities of its instances. Each instance contains the information that distinguishes it from the other instances. This information is a subset of its private variables called *instance variables*. All instances of a class have the same *number* of instance variables. The *values* of the instance variables are different from instance to instance. An object's software (ie: the methods that describe its response to messages) is found in its class. All instances of a class use the same method to respond to a particular type of message (ie: a message with a particular selector). The difference in response by two different instances is a result of their different instance variables. The methods in a class use a set of names to refer to the set of instance variables. When a message is sent, those names in the invoked method refer to the instance variables of the message receiver. Some of an object's private

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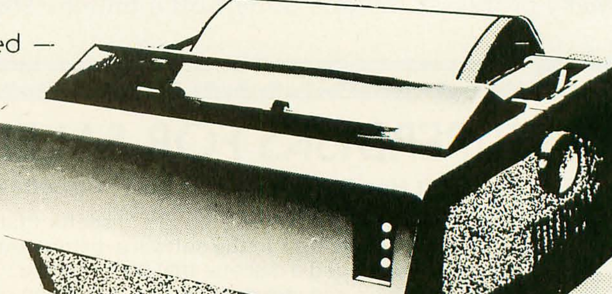


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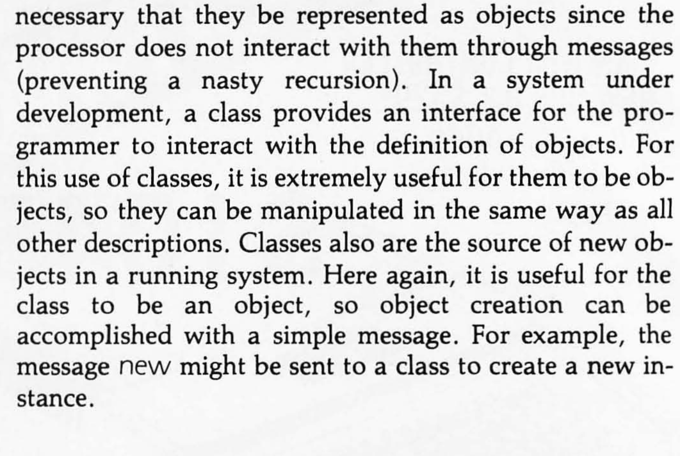
variables are shared by all other instances of its class. These variables are called *class variables* and are part of the class.

The programmer developing a new system creates the classes that describe the objects that make up the system. The programmer of the window-management system would create a class that contained methods corresponding to the message selectors move, display, delete, width, and height. This class would also include the names of the instance variables referred to in those methods. These names might be frame, text, and title, where:

> frame is a rectangle defining the area on the screen,
> text is the string of characters displayed in the window, and
> title is the string of characters representing the window's name

The classes representing rectangles and strings of characters are included in most systems, so they don't need to be defined.

In a system that is uniformly object-oriented, a class is an object itself. A class serves several purposes. In a running system, it provides the description of how objects behave in response to messages. The processor running an object-oriented system looks at the receiver's class when a message is sent to determine the appropriate



method to execute. For this use of classes, it is not necessary that they be represented as objects since the processor does not interact with them through messages (preventing a nasty recursion). In a system under development, a class provides an interface for the programmer to interact with the definition of objects. For this use of classes, it is extremely useful for them to be objects, so they can be manipulated in the same way as all other descriptions. Classes also are the source of new objects in a running system. Here again, it is useful for the class to be an object, so object creation can be accomplished with a simple message. For example, the message new might be sent to a class to create a new instance.

Inheritance

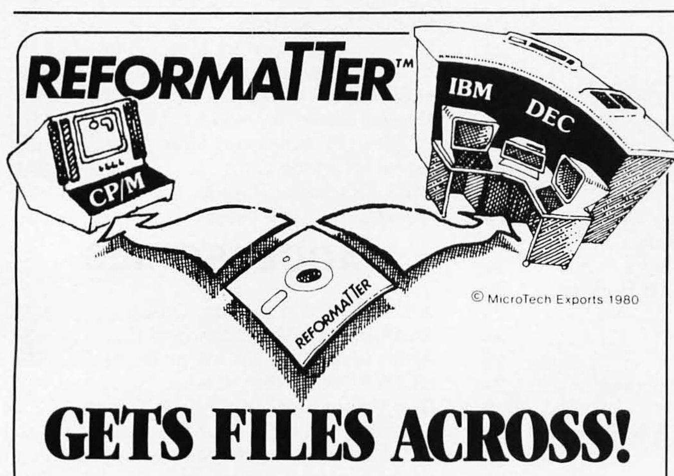
Another mechanism used for implicit sharing in object-oriented systems is called *inheritance*. One object inherits the attributes of another object, changing any attributes that distinguish the two. Some object-oriented systems provide for inheritance between all objects, but most provide it only between classes. A class may be modified to create another class. In such a relationship, the first class is called the *superclass* and the second is called the *subclass*. A subclass inherits everything about its superclass. The following modifications can be made to a subclass:

- adding instance variables
- providing new methods for some of the messages understood by the superclass
- providing methods for new messages (messages not understood by the superclass)
- adding class variables

As an example, the window-management system might contain windows that have a minimum size. These would be instances of a subclass of the ordinary class of windows that added an instance variable to represent the minimum size and provided a new method for the message that changes a window's size.

Conclusion

The realization that information can describe the manipulation of information is largely responsible for the great utility of computers today. However, that discovery is also partially responsible for the failure of computers to reach the utility of some predictions made in earlier times. On the one hand, it can be seen as a unification between the manipulator and the manipulated. However, in practice, it has been seen as a distinction between software and the information it manipulates. For small systems, this distinction is harmless. But for large systems, the distinction becomes a major source of complexity. The object-oriented point of view is a way to reduce the complexity of large systems without placing additional overhead on the construction of small systems. ■



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The Smalltalk Environment

Larry Tesler
Apple Computer Inc
10260 Bandley Dr
Cupertino CA 95014

As I write this article, I am wearing a T-shirt (photo 1) given to me by a friend. Emblazoned across the chest is the loud plea:

DON'T
MODE
ME IN

Surrounding the caption is a ring of barbed wire that symbolizes the trapped feeling I often experience when my computer is "in a mode."

In small print around the shirt are the names of some modes I have known and deplored since the early 1960s when I came out of the darkness of punched cards into the dawn of interactive terminals. My rogues' gallery of inhuman factors includes command modes like INSERT, REPLACE, DELETE, and SEARCH, as well as that inescapable prompt, "FILE NAME?" The color of the silk screen is, appropriately enough, very blue.

My friend gave me the shirt to make fun of a near-fanatical campaign I have waged for several years, a campaign to eliminate modes from the face of the earth—or at least from the face of my computer's display screen. It started in 1973 when I began work at the Xerox Palo Alto Research Center (PARC) on the design of interactive systems to be used by office workers for document preparation. My observations of secretaries learning to use the text editors of that era soon convinced me that my beloved computers were, in fact, unfriendly monsters, and that their sharpest fangs were the ever-present modes. The most common question asked by new users,

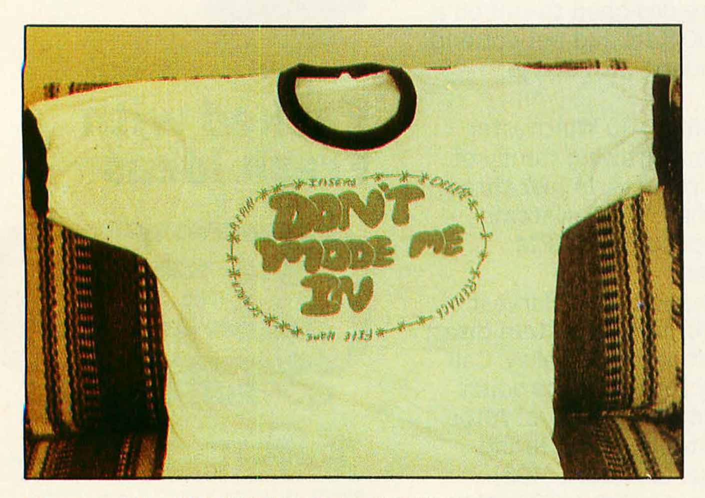


Photo 1: *The "DON'T MODE ME IN" T-shirt.*

at least as often as "How do I do this?," was "How do I get out of this mode?" Other researchers have also condemned the prevalence of modes in interactive systems for novice users (reference 1).

Novices are not the only victims of modes. Experts often type commands used in one mode when they are in another, leading to undesired and distressing consequences. In many systems, typing the letter "D" can have meanings as diverse as "replace the selected character by D," "insert a D before the selected character," or "delete the selected character." How many times have you heard or said, "Oops, I was in the wrong mode"?

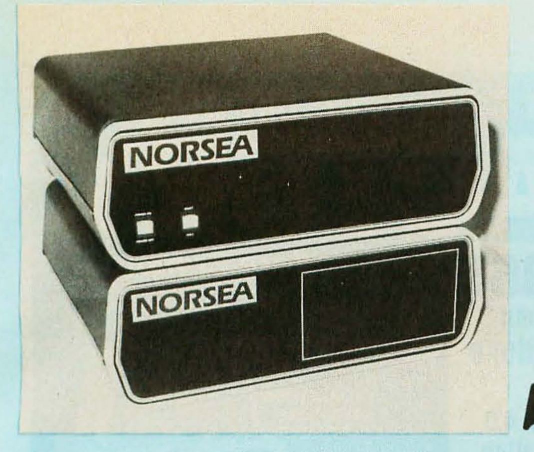
Preemption

Even when you remember what mode you are in, you can still fall into a trap. If you are running a data-plotting program, the only commands you can use are the ones provided in that program. You can't use any of the useful capabilities of your computer that the author of the program didn't consider, such as obtaining a list of the files on the disk. On the other hand, if you're using a program that lets you list files, you probably can't use the text editor to change their names. Also, if you are using a text editor, you probably can't plot a graph from the numbers that appear in the document.

If you stop any program and start another, data displayed by the first program is probably erased from the screen and irretrievably lost from view. In general, "running a program" in most systems puts you into a mode where the facilities of other programs are unavailable to you. Dan Swinehart calls this the *dilemma of preemption* (reference 2).

Many systems feature hierarchies of modes. A portion of a typical mode hierarchy is shown in figure 1. If you are in the editor and want to copy text from a file, you issue the *copy-from* command and it gives the prompt "from what file?" You then type a file name. What if you can't remember the spelling? No problem. Leave *from-what-file* mode, leave *copy-from* mode, *save* the edited text, *exit* from the editor to the executive, call up *file management* from the executive, issue the *list-files* command, look for the name you want (Hey, that went by too fast. Sorry, you can't scroll backwards in that mode.), *terminate* the list command, *exit* from file management to the executive, reenter the *editor*, issue the *copy-from* command, and when it prompts you with "from-what-file?," simply type the name (you haven't

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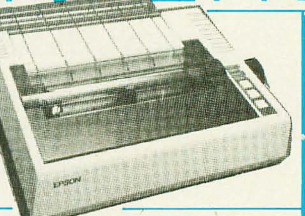


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Enter the Integrated Environment

Soon after I began battling the mode monster, I became associated with Alan Kay, who had just founded the Learning Research Group (LRG) at the Xerox PARC. Kay shared my disdain for modes and had devised a user-interface paradigm (reference 3) that eliminated one kind of mode, the kind causing the preemption dilemma. The paradigm he advocated was called "overlapping windows."

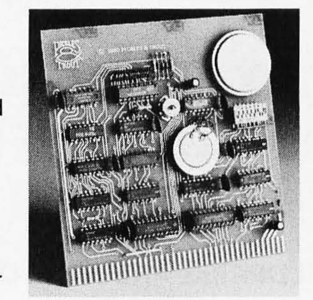
Most people who have used computer displays are familiar with windows. They are rectangular divisions of the screen, each displaying a different information set. In some windowing systems, you can have several tasks in progress, each represented in a different window, and can switch freely between tasks by switching between windows.

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The trouble with most windowing systems is that the windows compete with each other for screen space—if you make one window bigger, another window gets smaller. Kay's idea was to allow the windows to overlap. The screen is portrayed as the surface of a desk, and the windows as overlapping sheets of paper (photo 2). Partly covered sheets peek out from behind sheets that obscure them. With the aid of a pointing device that moves a cursor around the screen, you can move the cursor over a partly covered sheet and press a button on the pointing device to uncover that sheet.

The advantages of the overlapping-window paradigm are:

- the displays associated with several user tasks can be viewed simultaneously
- switching between tasks is done with the press of a button
- no information is lost switching between tasks
- screen space is used economically

Of course, windows are, in a sense, modes in sheep's clothing. They are more friendly than modes because you can't slip into a window unknowingly when you are not looking at the screen, and because you can get in and out of any window at any time you choose by the push of a button.

Kay saw his paradigm as the basis for what he called an "integrated environment." When you have an integrated environment, the distinction between operating system and application fades. Every capability of your personal computer is always available to you to apply to any information you want. With minimal effort, you can move among such diverse activities as debugging programs, editing prose, drawing pictures, playing music, and running simulations. Information generated by one activity can be fed to other activities, either by direct user interaction or under program control.

When Kay invented the Smalltalk language in 1972, he designed it with the ability to support an integrated en-

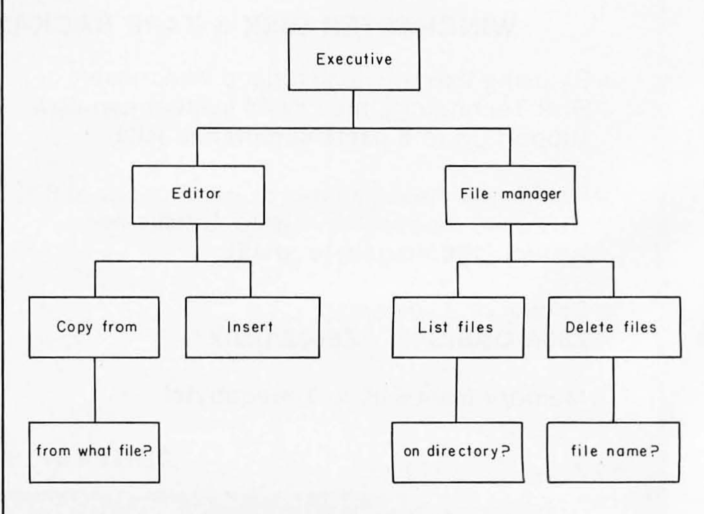
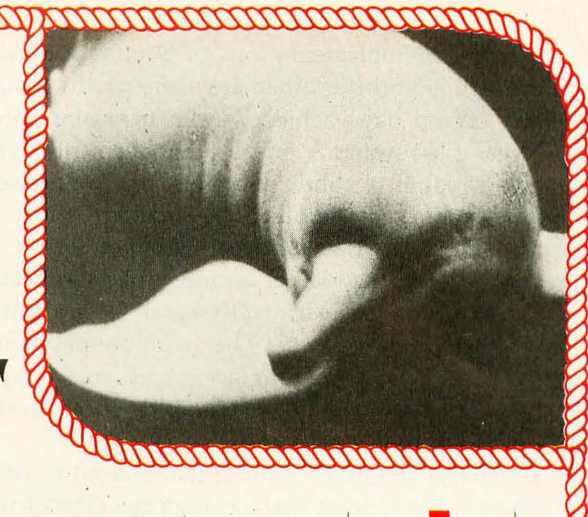


Figure 1: *A portion of a typical mode hierarchy.*

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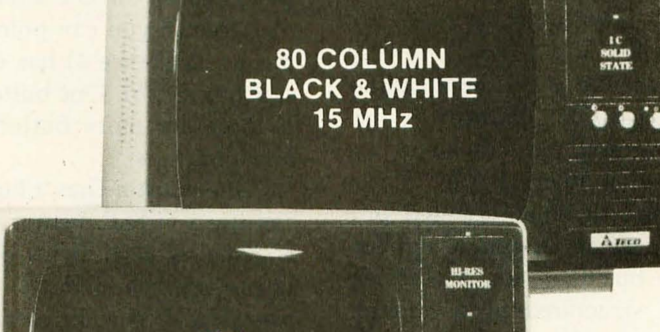
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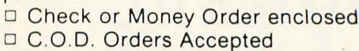


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vironment. The implementations of Smalltalk produced by Dan Ingalls and the other members of the Learning Research Group have achieved ever-increasing integration. The file system, process-management system, graphics capability, and compiler are implemented almost entirely in Smalltalk. They are accessible from any program, as well as by direct user interaction.

In recent years, the idea of an integrated environment has spread outside the Learning Research Group and even to non-Smalltalk systems. The window-per-program paradigm is now commonplace, and many system designers have adopted the overlapping-sheet model of the screen.

In summary, the term *environment* is used to refer to everything in a computer that a person can directly access and utilize in a unified and coordinated manner. In an *integrated environment*, a person can interweave activities without losing accumulated information and without giving up capabilities.

Strengths of Smalltalk

Before delving further into the *nature* of the Smalltalk environment, we should first discuss its *purpose*.

Many general-purpose programming languages are more suitable for certain jobs than others. BASIC is easy to learn and is ideal for small dialogue-oriented programs. FORTRAN is well suited to numerical applications. COBOL is tailored to business data processing. Pascal is good for teaching structured programming. LISP is wonderful for processing symbolic information. APL excels at manipulating vectors and matrices. C is great for systems programming. SIMULA shines at discrete simulations. FORTH lets people quickly develop efficient modular programs on very small computers.

All these languages have been used for numerous purposes in addition to those mentioned. You can write almost any program better in a language you know well than in one you know poorly. But if languages are compared from a viewpoint broader than that of a narrow expert, each language stands out above the others when used for the purpose for which it was designed.

Although Smalltalk has been used for many different applications, it excels at a certain style of software development on a certain type of machine. The machine that best matches Smalltalk's strengths is a personal computer with a high-resolution display, a keyboard, and a pointing device such as a *mouse* or graphics tablet (photo 3a). A cursor on the screen tracks mouse movements on the table so you can point to objects on the screen. The mouse (reference 4) has one or more buttons on its top side (photo 3b). One button is used as a *selection button*. If there are more buttons, they are normally used as *menu buttons*.

If the machine has a high-performance disk drive, you can use a virtual-memory version of Smalltalk and have as little as 80 K bytes of main memory, not counting display-refresh memory. Otherwise, you should have at least 256 K bytes of memory. This much memory is required because the whole integrated environment lives in one address space. It includes not only the usual run-time language support, but window-oriented graphics, the

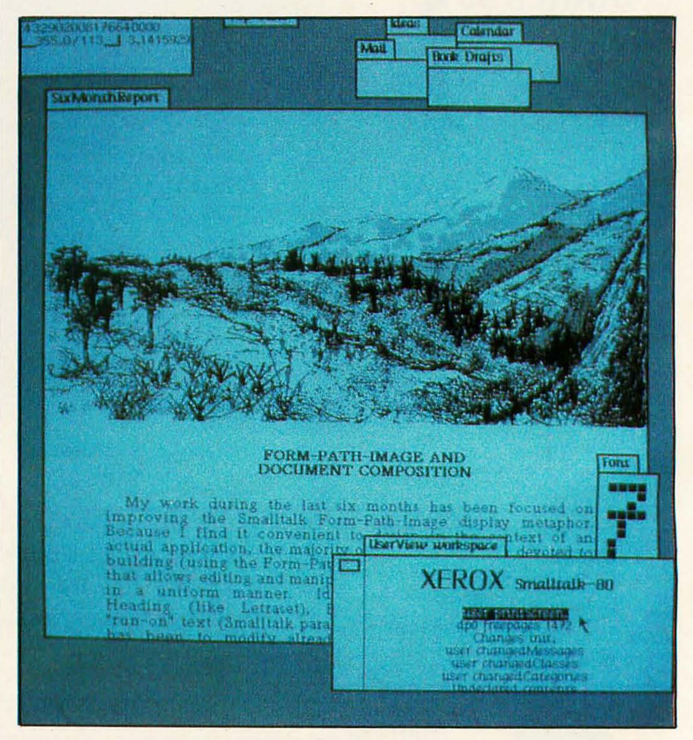


Photo 2: *A typical Smalltalk display. The various "windows" look and behave like overlapping sheets of paper.*

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editor, the compiler, and other software-development aids. The programs you write tend to be small because they can build on existing facilities; no system facilities are hidden from the user. Users of LISP and FORTH will be familiar with this idea.

Smalltalk supports its preferred hardware by incorporating software packages that provide:

- output to the user through overlapping windows
- input from a keyboard, a pointing device, and menus
- uniform treatment of textual, graphical, symbolic, and numeric information

These interactive facilities are utilized heavily by the built-in programming aids and are available to all user-written applications.

The style of software development to which Smalltalk is oriented is *exploratory*. In exploratory development, it should be fast to create and test prototypes, and it should be easy to change them without costly repercussions. Smalltalk is helpful because:

- The language is more concise than most, so less time is spent at the keyboard.

(3a)



(3b)



Photo 3: *A typical Smalltalk system (photo 3a) and a close-up of the "mouse" (photo 3b), a device that allows you to move an on-screen cursor and select certain options.*

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•Smalltalk programs grow gracefully. In most environments, a system gets more difficult to change as it grows. If you add 2 megabytes of virtual memory to the Smalltalk environment, you can fill the second megabyte with useful capabilities as fast as you can fill the first.

•The class structure of the language prevents objects from making too many assumptions about the internal behavior of other objects (see David Robson's article, "Object-Oriented Software Systems," on page 74 of this issue). The programmer can augment or change the methods used in one part of a program without having to reprogram other parts.

The Anatomy of a Window

Over the years, members of the Learning Research Group have embellished Kay's original window concept. Let us look at a Smalltalk window in more detail (figure 2).

The window is shown as a *framed* rectangular area with a *title tab* attached to its top edge. The program associated with the window must confine its output to the framed area.

Every window has a *window menu* (photo 4a). The window menu includes commands to reframe the window in a new size and location, to close the window, to print the contents of the window on a hard-copy device, and to retrieve windows hidden under it.

A window is tiled by one or more *panes*, each with its own *pane menu* (photo 4b). The pane menu includes commands appropriate to the contents of that pane. In

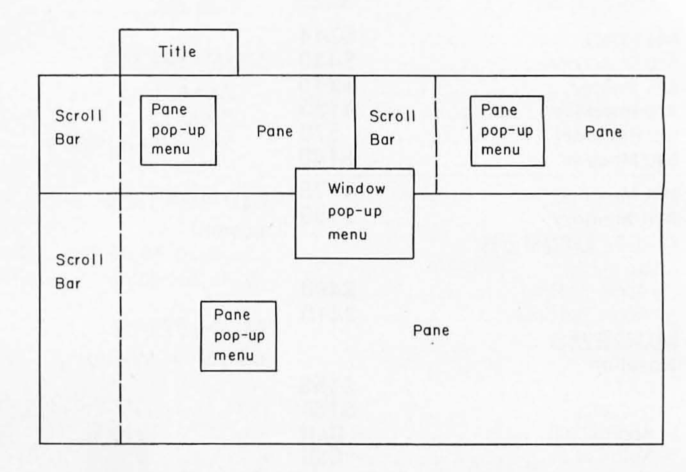


Figure 2: *Anatomy of a window.*

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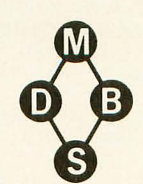
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addition, a pane has a *scroll bar* on its left side used to scroll the contents of the pane when more information exists than fits in the frame at one time.

Although you can see many windows and panes at once, you can interact with only one pane at a time. That pane and its window are said to be awake or *active*. To awaken a different pane of the same window, move the cursor over the new pane (photo 4c). To awaken a different window, move the cursor over the new window and press the *selection button* on the pointing device (photo 4d). When a window wakes up, its title tab and all its panes are displayed, and it is no longer covered up by other windows.

The scroll bar of the active pane is called the *active scroll bar*. Its menu and the menu of its window are called the *active menus*. In order to reduce screen clutter and maximize utilization of precious screen space, no inactive scroll bars or menus are displayed. On machines that use a pointing device with three buttons, some versions of Smalltalk even hide the active menus until one of two *menu buttons* is pressed, at which time the associated menu *pops up* and stays up until the button is released. If the button is released when the cursor is over a command in the menu, that command is executed (photo 4e).

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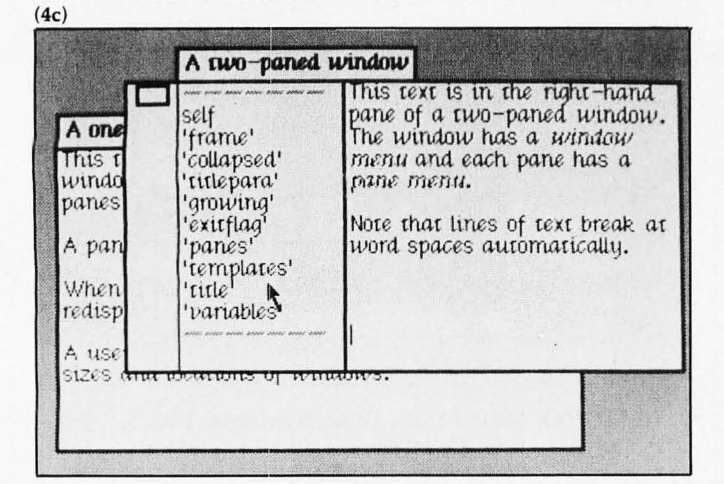
The overlapping-window paradigm helps eliminate preemption. It can also reduce the need for certain prompts and their associated modes. For example, you never have to type the name of a procedure you want to examine. At worst, you point to its name in a list; at best, the desired procedure is already in a window on the screen, and you activate that window.

Unfortunately, overlapping windows do not eliminate command modes like "insert" and "replace" by themselves. Between 1973 and 1975, I worked at PARC with various collaborators, including Dan Swinehart and Timothy Mott, to banish command modes from interac-

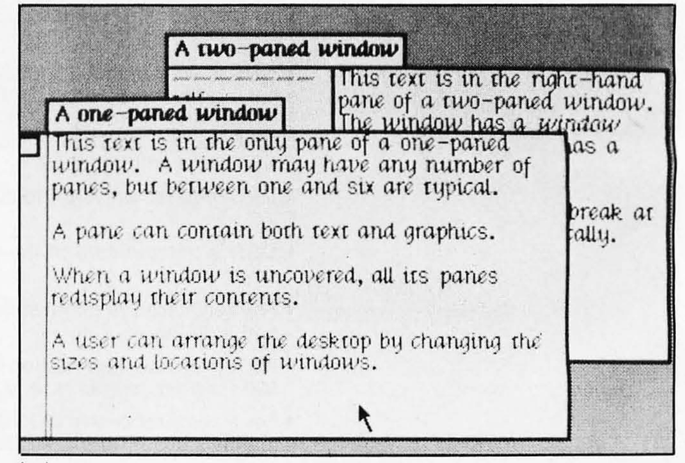
(4a)

(4b)

(4c)



(4d)



(4e)

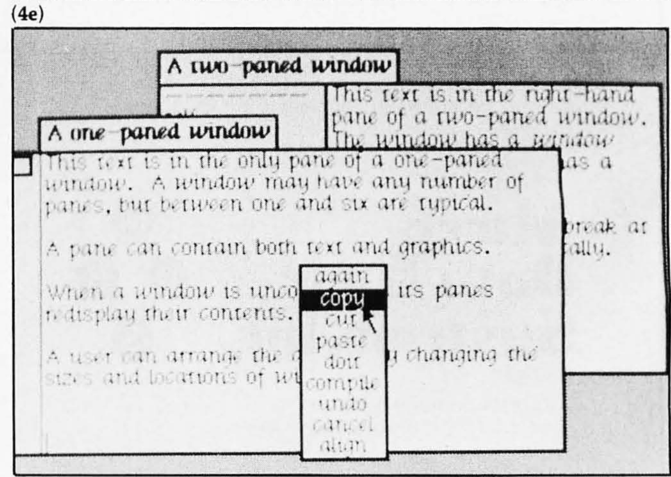


Photo 4: *Windows and their behavior.*

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54 dB.
Put up or shut up.

The Gauntlet Is Down

Can any dot matrix computer printer match the **INFOSCRIBE 1000**? Its sound level in normal, continuous operation is only 54 dBA. By independent sound laboratory test.*

That's right, 54 dBA. Like a group office where paper shuffling and throat clearing are making most of the noise.

As far as we're concerned, **INFOSCRIBE 1000** is the quietest serial matrix impact printer on the market.

Compare with the typical matrix printer that can sound like a blender full of ball bearings, and you have the Number One reason why your next printer will be an **INFOSCRIBE 1000**

Even printers advertised at 56dB are a **full 2 dB higher** than ours. (Remember, every 3 dB up doubles the noise.)

A New Generation Printer

If **INFOSCRIBE 1000's** purr were its only benefit, you should still buy it for the sanity of your office staff. But it happens that **INFOSCRIBE 1000** is also the most feature-packed, the most beautiful, and the most economical printer in its class.

Graphics Galore

INFOSCRIBE 1000 doesn't print characters only. Under software control it produces charts, diagrams, graphs, signs, anything within a vertical and horizontal resolution of 70 dots per inch. Now we're talking about a capability that can enhance management presentations, sales reports, even technical documents.

Format Flexibility

INFOSCRIBE 1000 can produce data processing quality characters at 10, 12, or 16.5 characters per inch, or correspondence quality characters at 10. You also get subscripts and superscripts in any selected pitch, double-wide printing, true lower case descenders, and true underlining.

In addition to two different character sets stored in the printer, a third character set can be downloaded from the host computer. This offers a total of 288 different characters that can be selected on a character-by-character basis.

Gratifying Throughput

There's more to **INFOSCRIBE 1000's** speed than a nominal 180 characters per second. High-speed paper movement with vertical and horizontal tabbing, plus bidirectional printing with logic seeking in both directions gets a lot of work out of the machine. And that's equivalent to having a faster computer.

Unmatched Elegance

It's almost unfair that **INFOSCRIBE 1000** is also the industry's best looking matrix printer. Slim, sleek, graceful, it makes those machines with the visible viscera look like remnants of early experimental days at Menlo Park. **INFOSCRIBE 1000** is completely enclosed, sealing dirt out while sealing noise in. Its controls use membrane switches, so not even knobs or buttons break its sculptured exterior.

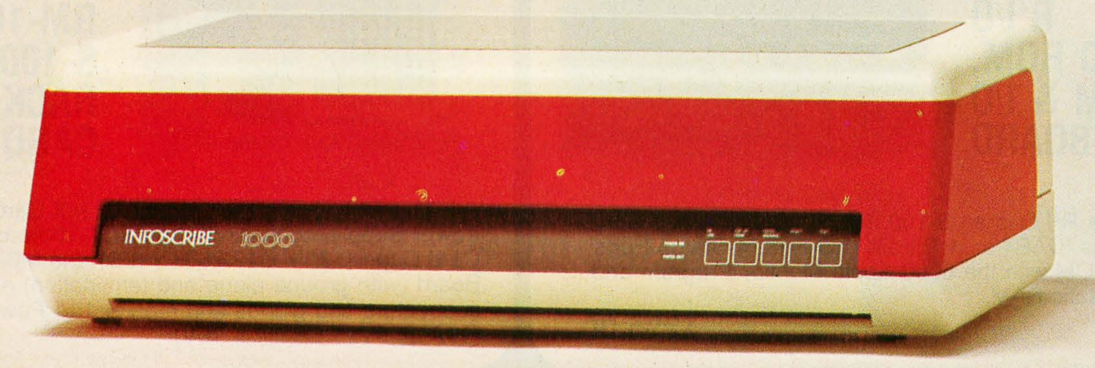
Demand the INFOSCRIBE 1000

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**Contact Infoscribe for an abstract of the independent testing laboratory report.*





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tive systems. Despite initial skepticism, nearly all users of our prototypes grew to appreciate the absence of modes. The following techniques were devised by us to eliminate modes from text editing. They are analogous to the techniques used to keep Polish-notation calculators relatively mode-free. Similar techniques can be applied to page layout, graphics creation, and other interactive tasks.

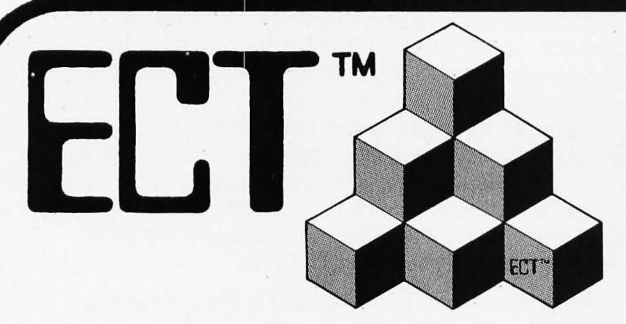
Selection precedes command:

• Every command is executed immediately when you issue it. You are not asked to confirm it. You can issue an *undo* command to reverse the effects of the last issued command. Although the main purpose of "undo" is to compensate for the lack of command confirmation, it can also be used to change your mind after issuing a command.
• For a command like "close the active window" that requires no additional parameters, you simply issue the command.
• For a command like "delete text" that requires one parameter, you first select the parameter using the pointing device and then issue the command. Until you issue the command, you can change your mind and make a different selection, or even choose a different command.
• For a command like "send electronic mail" that requires several parameters (recipient, subject, content), you first fill the parameters into a form using modeless text editing and then issue the command. You are not in a mode while filling out the form. If you want to copy something into the form from another place, you can. If you want to do something else instead, just do it; you may even return to the form later and finish filling it out.

Typing text always replaces the selected characters:

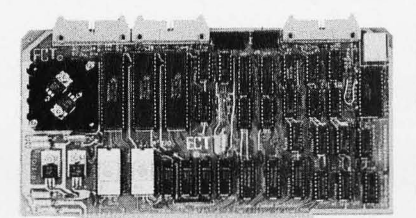
• Pressing a text key on the keyboard never issues a command. It always replaces the current selection by the typed character and automatically selects the gap following that character.
• To replace a passage of text, first select it (photo 5a) and then type the replacement. The first keystroke deletes the original text (photo 5b).
• To insert between characters, you first select the gap between those characters (photo 6a) and then type the insertion (photo 6b). Essentially, you are replacing nothing with something.
• The destructive backspace function always deletes the character preceding the selection, even if that character was there before the selection was made.
• The "undo" command (photos 6c and 6d) can be used to reverse the effects of all your typing and backspacing since you last made a selection with the pointing device.

Thus, the usual insert, append, and replace modes are folded into one mode—replace mode—and one mode is no mode at all.



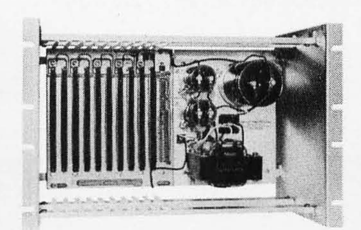
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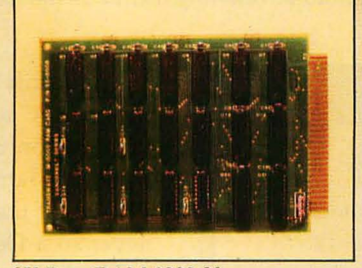
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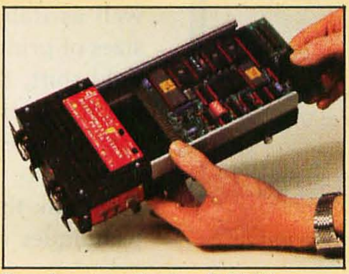
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Photo 5: *Replacing text in Smalltalk.*

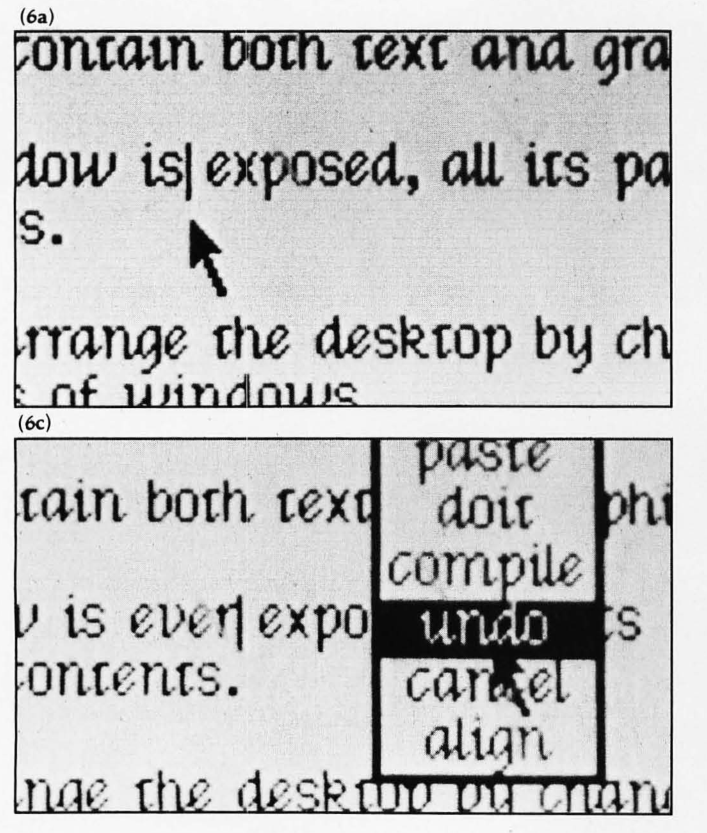


Photo 6: *Inserting text in Smalltalk.*

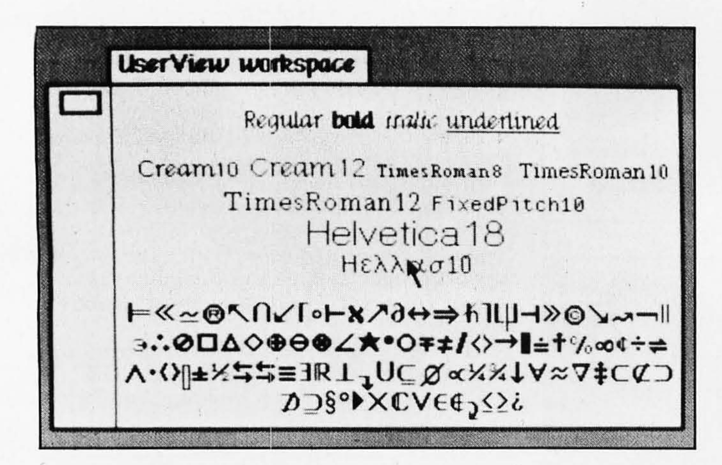


Photo 7: *Multiple typefaces can be used in any window.*

The "shift lock" key and analogous commands like "bold shift" and "underline shift" cause modes for the interpretation of subsequently typed characters. However, shifts are familiar to people and are relatively harmless. The worst they do is change a "d" to a "D," "**d**," or "<u>d</u>"—never to a Delete command.

The bit-map display can show boldface characters, as well as italics, underlining, and a variety of styles and sizes of printer's type (photo 7). Thus, as you enter text in bold shift, the screen shows what the text will look like when it is printed. A command like bold shift can also be applied to existing text to change it to boldface.

In 1976, Dan Ingalls devised a user interface for Smalltalk that incorporated most of the mode-avoidance techniques discussed earlier. Consequently, it is rare in

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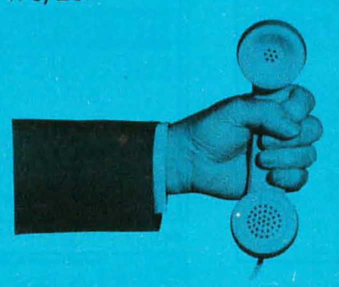
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the present Smalltalk environment to encounter a mode.

Making a Selection

In the Smalltalk-76 user interface, text is selected using the pointing device and a single button. First, the cursor is moved to one end of the passage to be selected (photo 8a). The selection button is pressed and held down while the cursor is moved to the other end of the passage. This operation is called "draw-through," though it is not necessary to traverse intermediate characters en route to the destination. When the cursor reaches the other end of the passage, the button is released. The selected passage is then shown in inverse video (photo 8d).

The feedback given to the user during selection is as follows. When the button is depressed, a vertical bar appears in the nearest intercharacter gap (photo 8b). (At the left end of a line of text, the bar appears to the left of the first character. At the right end of a line, the bar appears to the left of the final space character.)

If the button is released without moving the cursor, the bar remains, indicating that a zero-width selection has been made. This method—clicking once between characters—is the one to use before you insert new text.

If the button is held down while the cursor is moved, the system supplies continuous feedback by highlighting in inverse video all characters between the initial bar and the gap nearest to the cursor (photo 8c). When the button is released, the selected characters remain highlighted (photo 8d). This method—drawing through a passage—is the one to use before you copy, move, delete, or replace text, or before you change it to boldface or otherwise alter its appearance.

Clicking the button twice with the cursor in the same spot within a word selects that whole word and highlights it (photo 8e). This special mechanism is provided because it is very common to select a word. Informal experiments lead us to believe that double clicking is much easier than drawing through a word for beginners and experts alike. It is also faster. It takes the average user about 2.6 seconds to select a word anywhere on the screen using draw-through, but it takes only 1.5 seconds using the double click (reference 5).

There is only one selection in the active pane. It is called the *active selection*.

(8a)

(8b)

(8c)

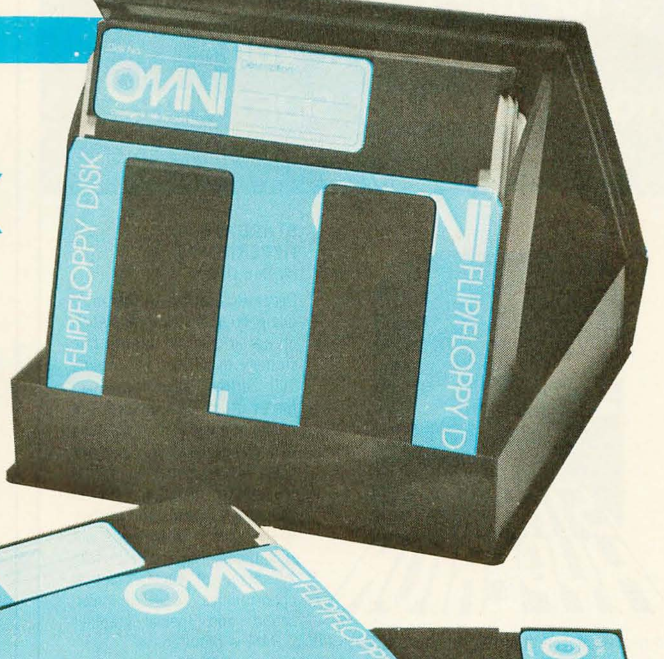
(8d)

(8e)

Photo 8: *Selecting text using the mouse and the cursor.*

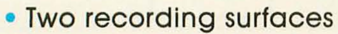
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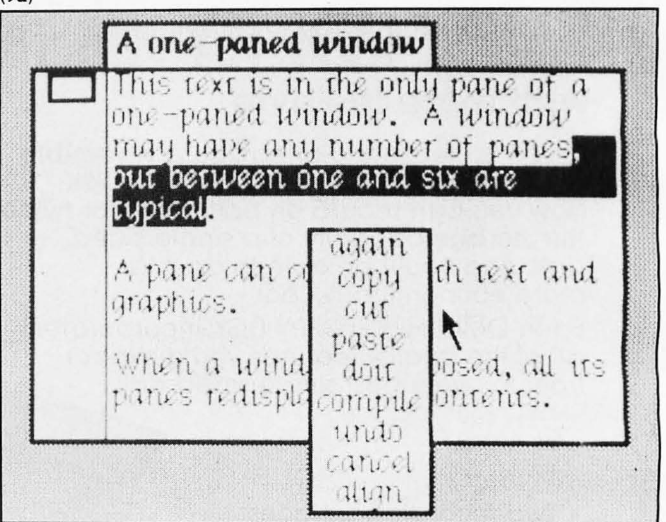
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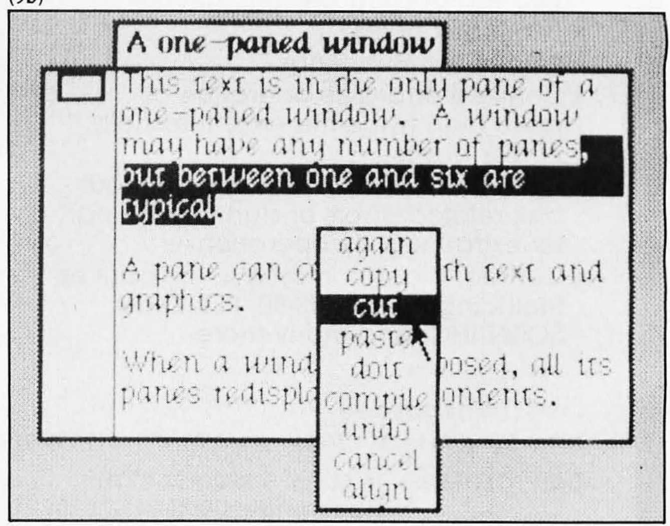
Issuing a Command

When you issue a command in Smalltalk, you are sending a message to an object. There are two ways to send a message from Ingalls's user interface. You can send certain commonly sent messages to the active pane or window by choosing them from menus; you can send any message to any object by direct execution of a Smalltalk statement.

(9a)



(9b)



(9c)

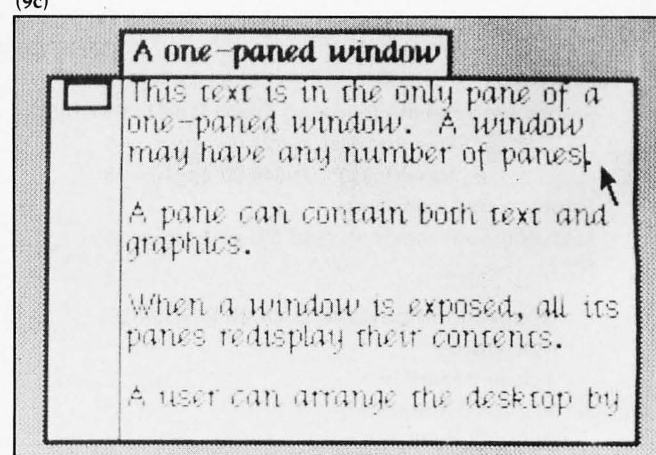


Photo 9: *"Cutting" text in Smalltalk.*

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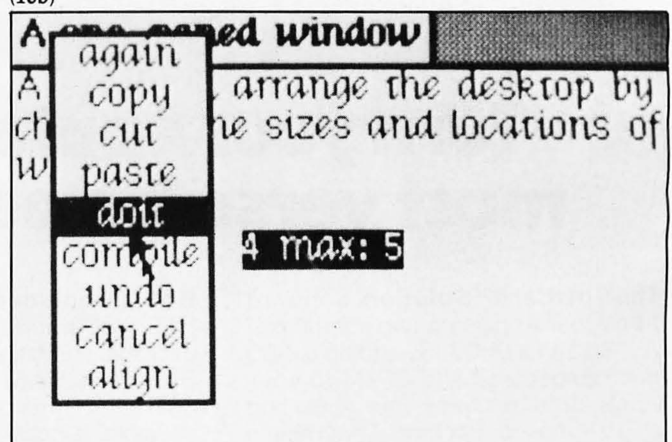
Smalltalk-76 provides pop-up menus for the most commonly used commands, like "cut," which deletes the selected text. To issue the "cut" command, you pop up the active-pane menu with one of the menu buttons on the mouse (photo 9a), keep that button down while moving the cursor to the command name (photo 9b), and then release the button (photo 9c). A command in the pane menu can have only one parameter, the active selection. A command in the window menu can have no parameters.

To issue a command that is not available in a menu, you select any place you can insert text, and type the whole command as a statement in the Smalltalk language (photo 10a). Then you select that statement and issue the

(10a)

A one-paned window
A user can arrange the desktop by changing the sizes and locations of windows.
4 max: 5

(10b)



(10c)

A one-paned window
A user can arrange the desktop by changing the sizes and locations of windows.
4 max: 5 5

Photo 10: *Executing text using the "doit" message.*

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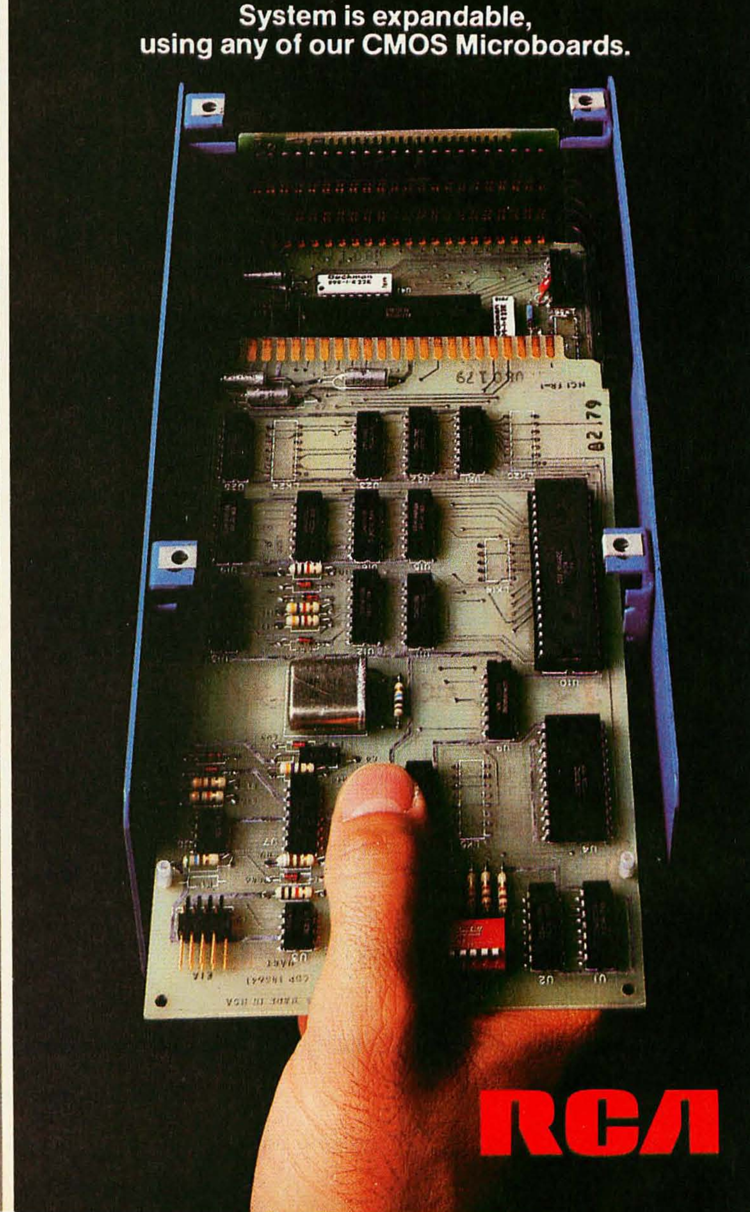
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single-parameter command "do it" (photo 10b) to obtain the result (photo 10c). The "do it" command provides immediate execution of any Smalltalk statement or group of statements. This method of command issuance uses the previous method: you are sending the message *doit* to the pane, with the Smalltalk statement as its parameter.

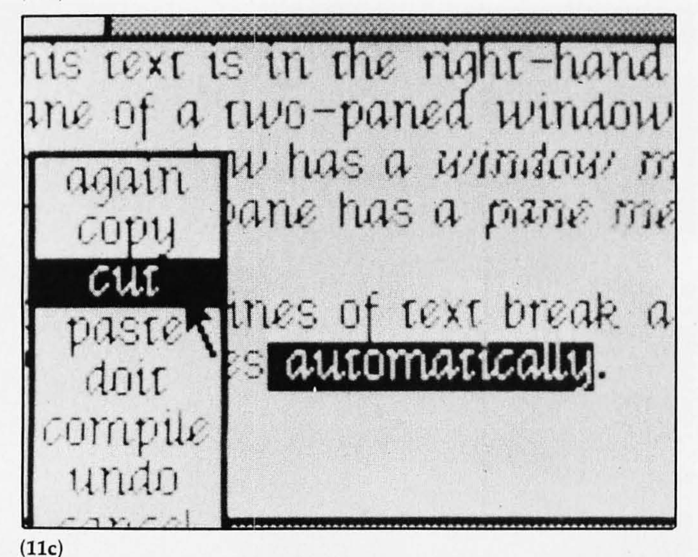
It is standard practice to keep a "work-space" window around the screen in which to type your nonmenu commands. When you want to reissue a nonmenu command issued earlier, simply select the command in the work-space window and "do it." You may, of course, edit some of the parameters of the old command before you select it and "do it." In a sense, you are filling out a form when you edit parameters of an immediate statement.

Unfortunately, the common commands "move text from here to there" and "copy text from here to there" cannot be issued by a single menu command because they require two parameters, the source selection and the destination selection. Sometimes, they even involve messages to more than one pane, the source pane and the destination pane. In a modeless system, a move or copy command is done in two steps:

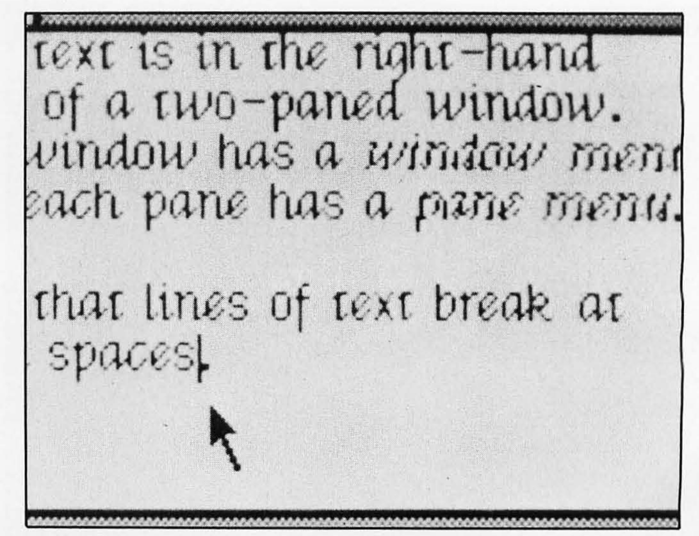
- A move is done by *cut and paste*. First, you select the source text and issue the "cut" command (photo 11a). The "cut" command deletes the selected text (photo 11b), but leaves it in a special place where it can be retrieved by "paste." Then you select the destination and issue the "paste" command (photo 11c) to complete the move (photo 11d).
- A copy is done by *copy and paste*, which is completely analogous to cut and paste, but does not delete the original text.

Remember the "copy-from-file" example (the one where you had to go in and out of many layers of modes)? In the Smalltalk-76 user interface, you can accomplish this with six pushed buttons, no mode exits, and no typing: (1) activate the source window that displays the file you are copying from; (2) select the desired text; (3) issue the "copy" command in the menu; (4) activate the destination window; (5) select the destination point, and (6) issue the "paste" command in the menu. The job requires little more effort than copying within the same document. If the window is not already

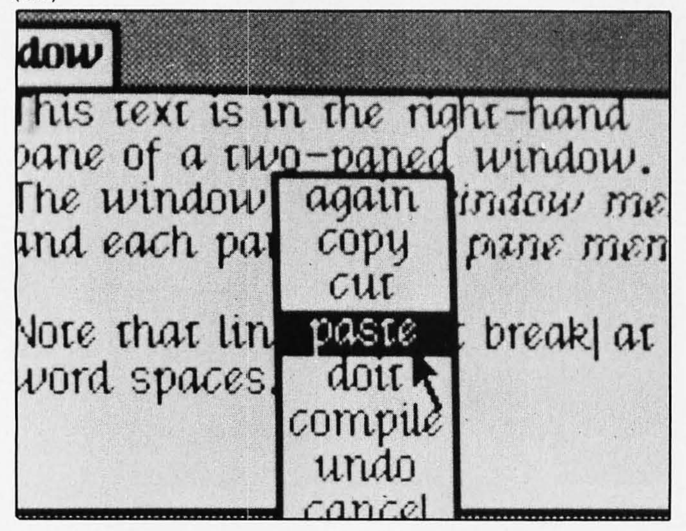
(11a)



(11b)



(11c)

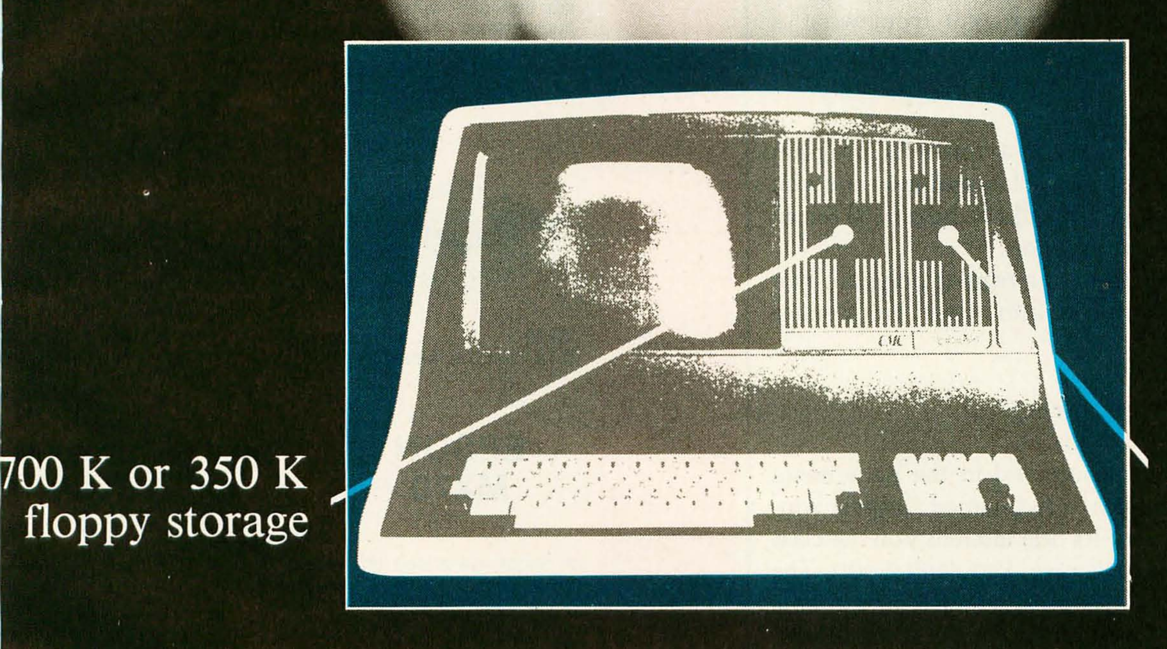


(11d)

Photo 11: *Moving text in Smalltalk.*

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Circle 56 on inquiry card.

on the screen and you can't remember the file name, you can go to another window and scroll through a list of files without having to exit any modes, invoke any programs, save any edits, lose sight of the destination file, or lose any time.

The Smalltalk-76 text-editing facilities not only relieve you of the burden of modes, they also require very few keystrokes and are easy to learn.

Software-Development Aids

One of my summer projects in 1977 was to increase the speed and friendliness of the Smalltalk software-development environment by adding *inspect windows, browse windows,* and *notify windows* to the user interface. These and other enhancements made by the Learning Research Group are described below. In recent months, the team has further enhanced the Smalltalk-80 environment. Although it conforms to the same principles as before, its details are different from what is described in this article.

Inspecting Data Structures

Suppose someone has given you a Smalltalk program to implement a "regular polygon" class (table 1) and you want to learn more about it. It would be helpful to see an actual instance of a regular polygon.

If the variable triangle refers to a regular polygon, you type the following statement into your work-space window:

```
triangle inspect
```

and then issue the "do it" command in the pane menu (photo 12a). In a few seconds, a two-paned "inspect window" appears on the screen. Its title tab tells you the class of the inspected object, in this case, RegularPolygon. The window is divided into two panes. The left or *variable pane* lists the parts of a regular polygon, sides, center, radius, and plotter. The right or *value pane* is blank.

You point to the word sides in the variable pane and click the selection button on the mouse. The word sides is highlighted, and in the value pane, the value of the variable sides appears (photo 12b), in this case, 3. You point to the word center and click. In the value pane appears the value of center (photo 12c), in this case, the point 526@302. The value pane is *dependent* on the variable pane because its contents are determined by what you select in the variable pane. The arrow in figure 3 symbolizes this dependency.

Let's inspect the value of center. In the variable pane, where center is selected, pop up the pane menu and issue

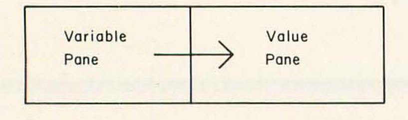


Figure 3: *Principal dependencies among panes of an inspect window.*

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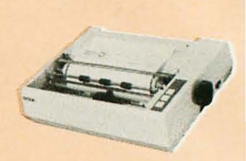
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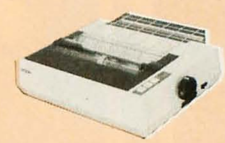
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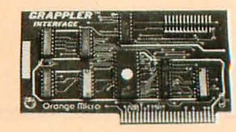


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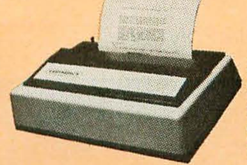
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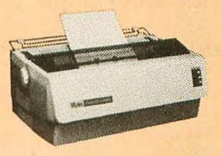


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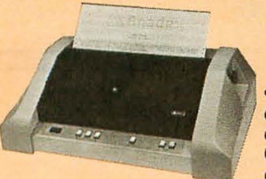


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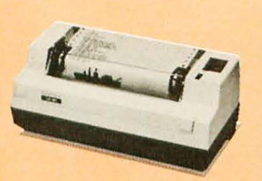
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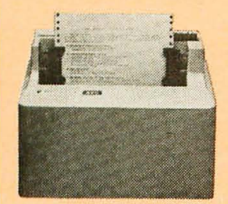
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The following template contains a description of a regular polygon with the following attributes:

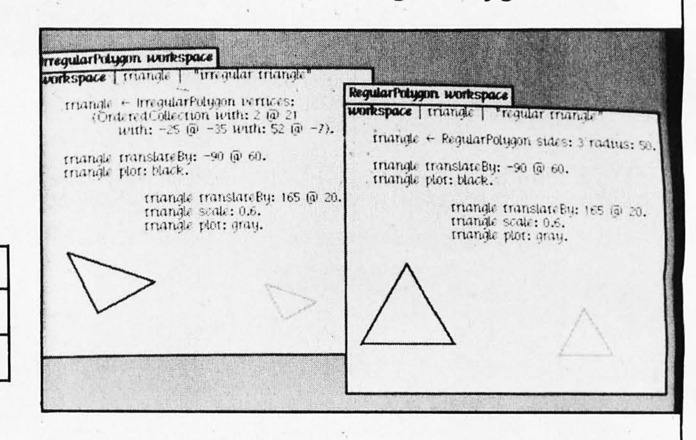
sides	Number of sides (3 for a triangle, 5 for a pentagon, etc.).
center	If the regular polygon were inscribed in a circle, this would be its center point.
radius	If the regular polygon were inscribed in a circle, this would be its radius.
plotter	A pen that can draw an image of the polygon on the screen or on paper.

The following expressions provide an example of creating and using an instance of RegularPolygon.

```
triangle ← RegularPolygon sides: 3 radius: 50.

triangle translateBy: -90 @ 60.
triangle plot: black.

triangle translateBy: 165 @ 20.
triangle scale: 0.6.
triangle plot: gray.          "where gray denotes an ink color"
```



class name	RegularPolygon
superclass	Object
instance variable names	sides center radius plotter
class messages and methods	

```
initialization
   sides: s radius: r | |
      "Create an instance of RegularPolygon whose center is located at the center of the currently active window on the display screen. Screen is a global variable that refers to the hardware display screen."
      ↑ self new sides: s radius: r center: (Screen activeWindow frame center)
```

instance messages and methods

```
initialization
   sides: s radius: r center: c | |
      "Initialize all attributes. Class Pen is provided in the system as one way of side effecting the display screen."
      sides ← s.
      center ← c.
      radius ← r.
      plotter ← Pen width: 2
analysis
   center | |                                    "Answer the center coordinate of the polygon."
      ↑center
   sides | |                                     "Answer the polygon's number of sides."
      ↑sides
display
   plot: ink | |                                 "Draw an image of the polygon using the specified ink color."
      plotter penup.                             "lift the pen to disable drawing"
      plotter goto: self center.                 "position the pen at the center"
      plotter up.                                "face the top of the screen"
      plotter go: radius.                        "position at a corner"
      plotter turn: 180 - (self cornerAngle/2).  "turn to face along a side"
      plotter color: ink.                        "select the ink color"
      plotter pendn.                             "lower the pen to enable drawing"
      1 to: sides do:                            "for each side of the polygon:"
         [:i | plotter go: self sideLength.      "plot that side"
            plotter turn: 180-self cornerAngle]  "turn to face along the next side"
transformation
   scale: factor | |
      "Scale the polygon radius by the specified factor."
      radius ← radius * factor
   translateBy: deltaXY | |
      "Change the polygon's location by the specified amount (a Point)."
      center ← center + deltaXY
private instance methods
   cornerAngle | | "Answer the interior angle of any vertex, in degrees."
      ↑180 - (360 / sides)
   sideLength | | "Answer the length of any one of the equal sides."
      ↑2 * radius * (self cornerAngle /2) degreesToRadians cos
```

Table 1: *Description and class template for class* RegularPolygon.

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the "inspect" command (photo 12d). On the screen appears another inspect window showing that center is an instance of class Point (photo 12e). You can now examine that point's variables, x and y, reactivate the original inspect window, close either or both windows, or work in any other window. You are not in a mode.

(12a)

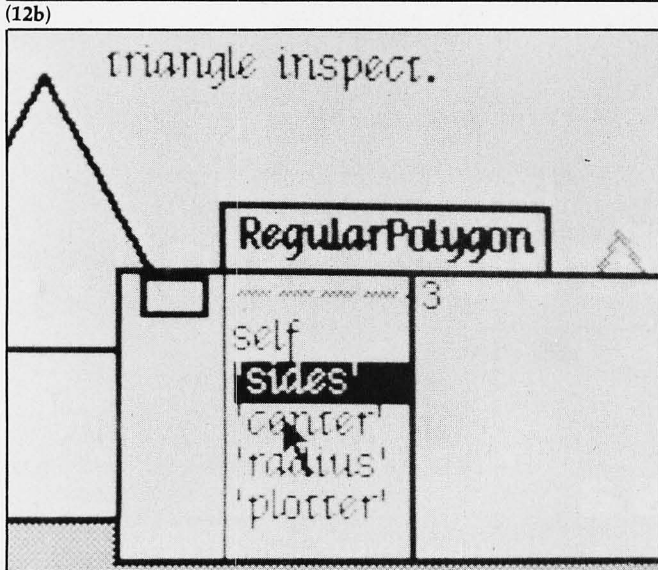
Browsing Through Existing Definitions

Now that you have inspected a sample regular polygon, you might want to find out what methods have been defined in its class. One way to do this is to activate a window called a "browse window" or "browser." Most Smalltalk programmers leave a browser or two on the screen at all times with the work-space window.

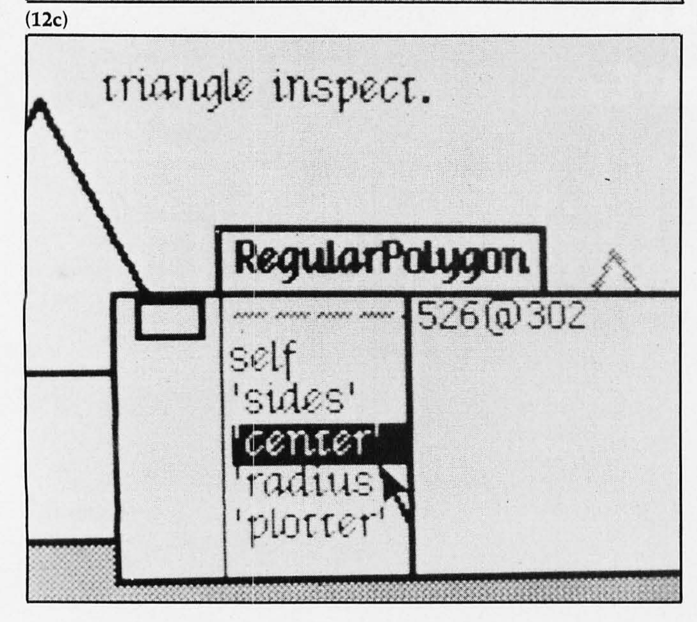
The title tab of the browser (photo 13a) says "Classes" because the standard browser lets you examine and change the definitions of all Smalltalk classes—classes supplied by the system, as well as classes supplied by yourself. It is easy to create a more restricted browser that protects the system from ill-conceived modification. But on a personal computer, you are just going to hurt yourself.

The browser has five panes. The principal dependen-

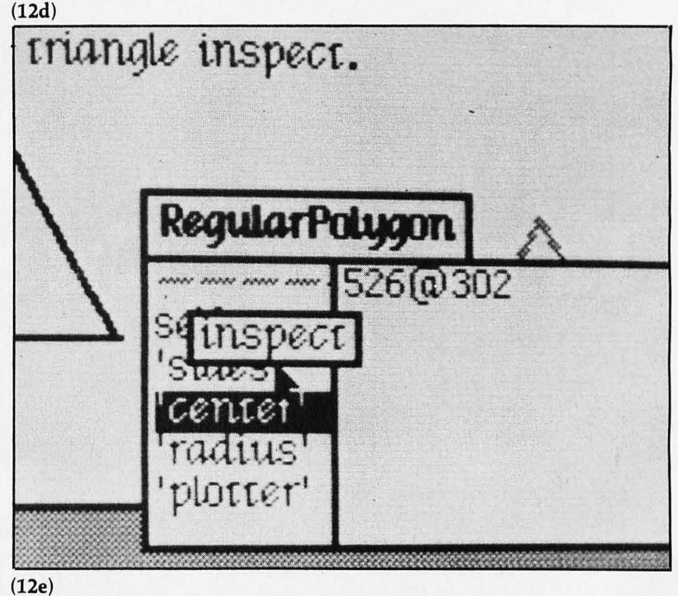
(12b)



(12c)



(12d)



(12e)

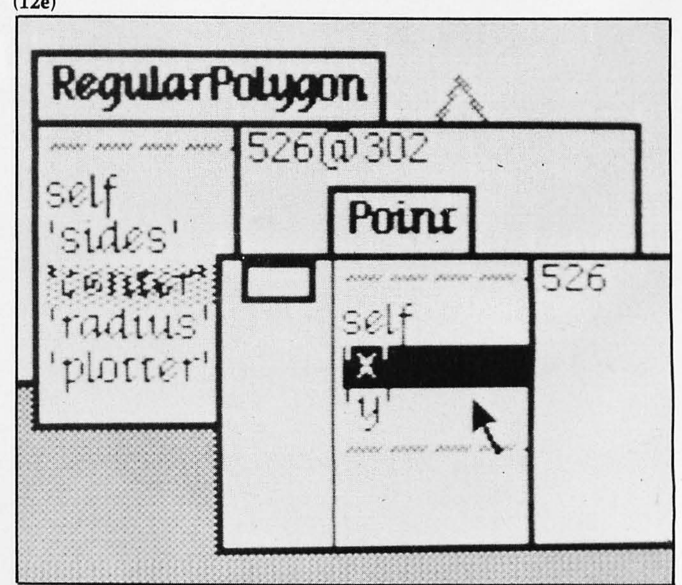


Photo 12: *Inspecting data structures in Smalltalk.*

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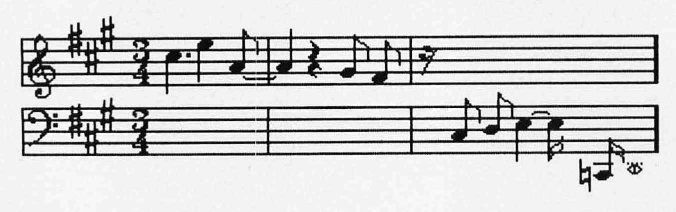


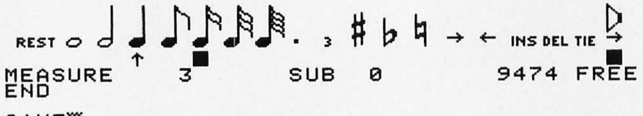
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—Burbank, California

About ease of use:

I have had my Music Card MC1 for a little more than a week now and I have almost completed entering "The Maple Leaf Rag". I found it to be a lot simpler than I thought and so I am very, very pleased. My family isn't because I sit up to all ends of the night playing with the blasted thing!
—Cypress, Texas

ALF has opened up my head and ears and enabled me to do things musically which I would like to be able to do on [conventional] instruments. As much as I love the instruments I try to play, I just don't have the talent and technique to play what is in my head. By golly, the ALF board doesn't know about my limitations, though. I can play hell out of that thing, playing notes and tempos which previously have existed only in my head. Many thanks from a frustrated musician and satisfied ALF "player".
—Demopolis, Alabama

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—Lancaster, California

About the competition:

Recently, I purchased an [ALF] 9-voice board and a couple of music albums . . . . all I can say is that I wish I had listened and played with it before I purchased the Mtn. Hardware board. It sounds about the same and is vastly superior in software, ease of use, and price. The Entry program is a joy to use and it's easier than Mtn. Hardware's, but then, I guess you guys know that already. (Oh yes, you wouldn't happen to know of anyone that wants to buy a Mtn. Hardware system? $450 or best offer?)
—Kirkland, Washington

I would like to tell you that after having used the system ONLY ONE DAY, that I am absolutely delighted with it. In addition, I purchased the three boards although I ALREADY own Mountain Hardware's music system. Now that I have seen and own your system, I am putting my "old" one up for sale. I think that your software makes it far easier to enter music, and that the software routines allow for far greater flexibility. Again, I extend my compliments to you. As I said, I have owned another music system, and consider myself therefore, qualified to make a judgement between the use of the two. Yours is the clear choice!
—Levittown, New York

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cies between panes are symbolized by arrows in figure 4. The top row has four panes called the *class-category pane, class pane, method-category pane,* and *method pane*. The large lower pane is called the *editing pane*. (After you have used the system for a few minutes, the significance of each pane becomes apparent, and it is not necessary to memorize their technical names.)

In photo 13a, the browser shows a method definition in the editing pane. You can tell that the method is class RegularPolygon's version of scale: because RegularPolygon is highlighted in the class pane and scale: is highlighted in the method pane.

The method-category pane lists several groups of methods within class RegularPolygon: **initialization, analysis, display, transformation, testing,** and **private** methods. You can tell that scale: is a **transformation** message in class RegularPolygon because that category is highlighted.

The class-category pane lists several groups of classes, including **numbers, files,** and **graphical objects**. You can tell that class RegularPolygon is in the **graphical objects** group because that category is highlighted.

Suppose you want to look at a different method, translateBy:. Click its name in the method pane and its definition is immediately displayed in that pane's dependent, the editing pane (photo 13b). If the method you want to see is in the method category **analysis**, first click that category name. Immediately after you do that, its dependent, the method pane, lists the methods in that category. Now you can click the name of the desired method (photo 13c).

If you want to know things about the class as a whole, like its superclass and field names, click "Class Definition" in the method-category pane and the definition appears in the editing pane (photo 13d).

Suppose you want to look at a different class, say IrregularPolygon. Click its name in the class pane and its method categories are immediately displayed in the next pane (photo 13e). If the class you want to see is in the class category **windows**, first click that category name. Immediately after you do that, the class pane lists the classes in that category. Now you can click the name of

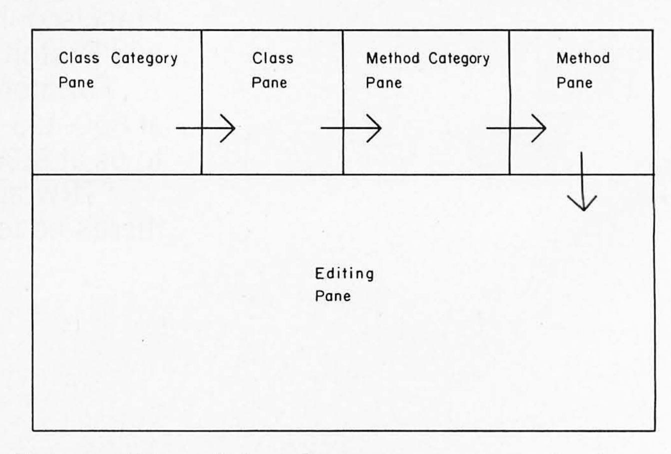


Figure 4: *Principal dependencies among panes of a browse window.*

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the desired class (photo 13f).

Categorization is used at both the class and method level to help the programmer organize his or her program and to provide fewer choices in each pane. If a list is longer than what can fit in a pane, it can be scrolled by pressing a mouse button with the cursor in the scroll bar.

If you just want to browse around reading class and method definitions, you can do so by lazily clicking the selection button with the cursor over each name, never touching the keyboard. That is why the window is called a browser. Browsers are further discussed in references 6 and 7.

Astute readers may have noticed that the class template (see "The Smalltalk-80 System" by the Learning Research Group on page 36 of this issue) presents the methods of a class apart from the methods of its instances, while the browser does not. This discrepancy stems from differences between the Smalltalk-80 and Smalltalk-76 languages.

Revising Definitions

If you are looking at a method definition or class definition in the editing pane, you can revise it using the standard text-editing facilities (select, type, cut, paste, copy).

If you like, you can copy information into the definition from other windows—including other browse windows—because you are not in any mode while browsing. You can even interrupt your editing to run another program, list your disk files, draw a picture, or do whatever you like. You can later reactivate the browser and continue editing.

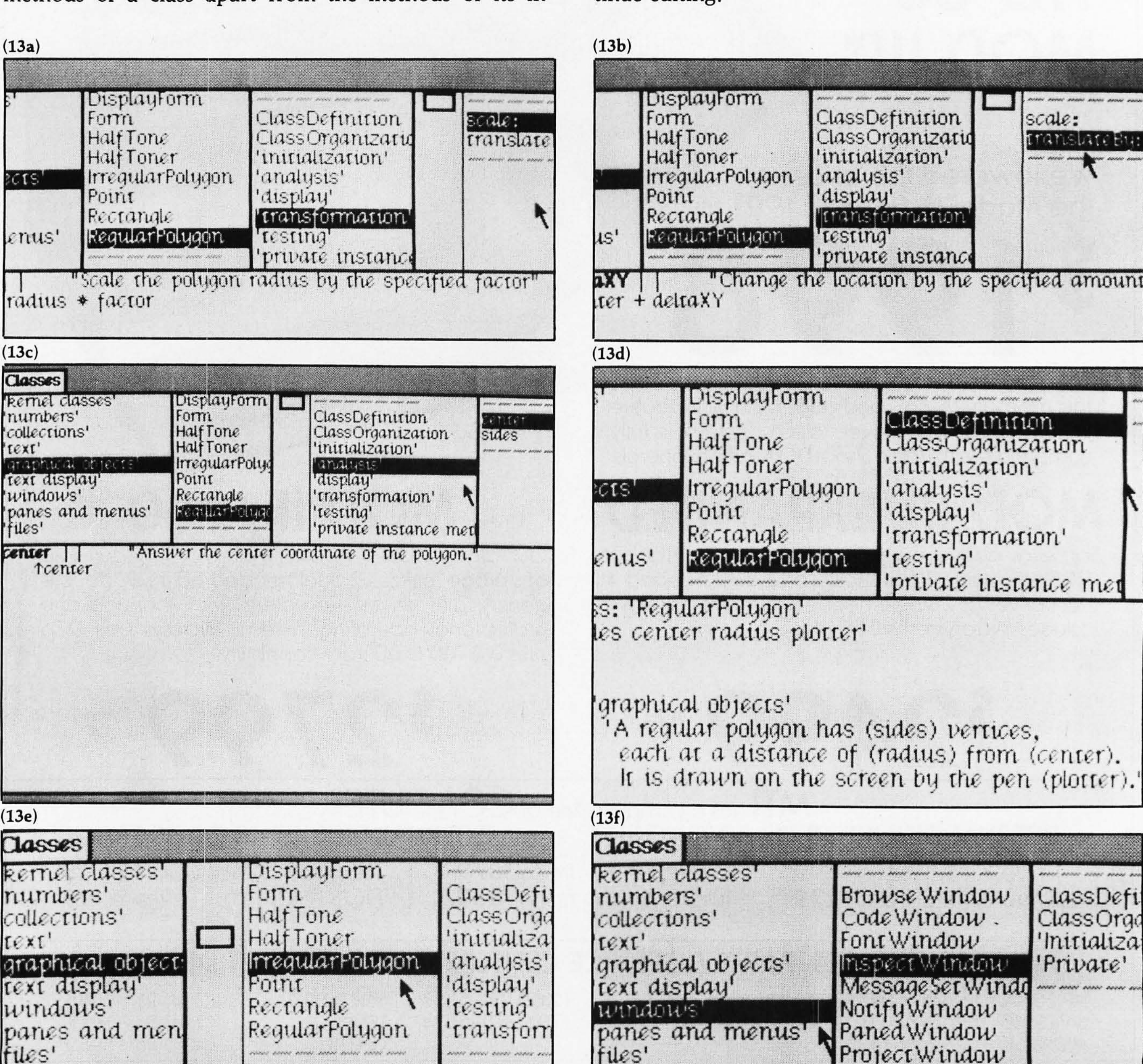


Photo 13: *Browsing through existing definitions in Smalltalk.*

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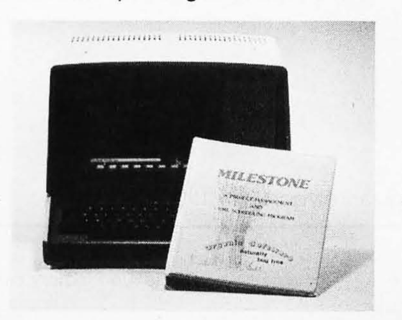
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The following template contains a description of an irregular polygon with the following attributes:

vertices	An OrderedCollection of Points.
plotter	A pen that can draw an image of the polygon on the screen or on paper.

The following expressions provide an example of creating and using an instance of IrregularPolygon.

```
triangle ← IrregularPolygon vertices:
                    (OrderedCollection with: 2 @ 21
                                       with: -25 @ -35
                                       with: 52 @ -7).
triangle translateBy: -90 @ 60.
triangle plot: black.

triangle translateBy: 165 @ 20.
triangle scale: 0.6.
triangle plot: gray.  "where gray denotes an ink color"
```

class name	IrregularPolygon
superclass	Object
instance variable names	vertices plotter
class messages and methods	

```
initialization
   vertices: aCollection | |
   "Create an instance of IrregularPolygon whose center is located at the center of the currently active window on the display screen.
   Screen is a global variable that refers to the hardware display screen."
   ↑ self new vertices: aCollection center: (Screen activeWindow frame center)
```

instance messages and methods	

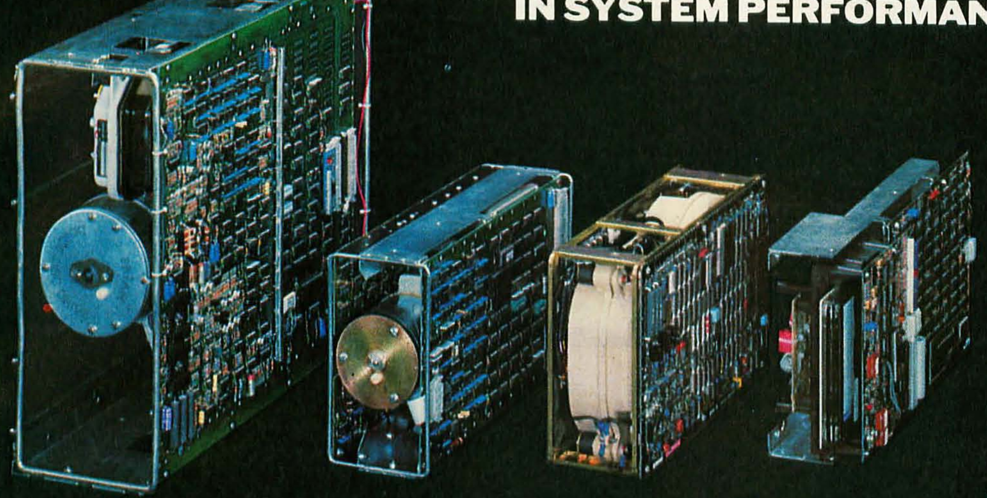
```
initialization
   vertices: aCollection center: c | |
    "Initialize all attributes. Class Pen is provided in the system as one way of side effecting the display screen."
    vertices ← aCollection.
    plotter ← Pen width: 2.
    self translateBy: c - self center
analysis
   center | sum |                          "Answer the center coordinate of the polygon."
    sum ← 0@0.
    vertices do: [ :pt | sum ← sum + pt].
    ↑sum / self sides
   sides | |                               "Answer the polygon's number of sides."
    ↑vertices size
display
   plot: ink | |                           "Draw an image of the polygon using the specified ink color."
    plotter penup.                         "lift the pen to disable drawing"
    plotter goto: vertices last.           "position the pen at one vertex"
    plotter color: ink.                    "select the ink color"
    plotter pendn.                         "lower the pen to enable drawing"
    vertices do:                           "for each vertex"
      [:pt | plotter goto: pt]             "draw a straight line to it"
transformation
   scale: factor | center |
    "Scale the polygon by the specified factor."
    center ← self center.                  "the center of expansion"
    vertices ← vertices collect:           "generate new vertex list from old list"
      [ :pt | (pt - center)*factor + center]
   translateBy: deltaXY | |
    "Change the polygon's location by the specified amount (a Point)."
    vertices ← vertices collect: [:vertex | vertex + deltaXY]
```

Table 2: *Description and class template for class* IrregularPolygon.

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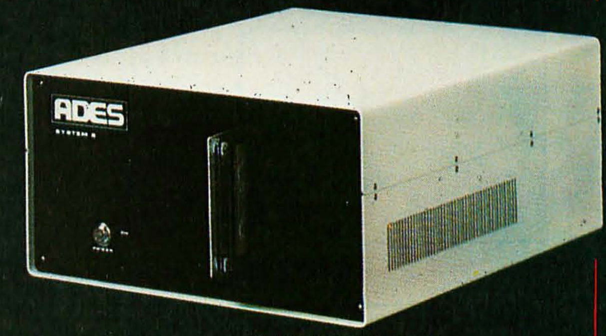
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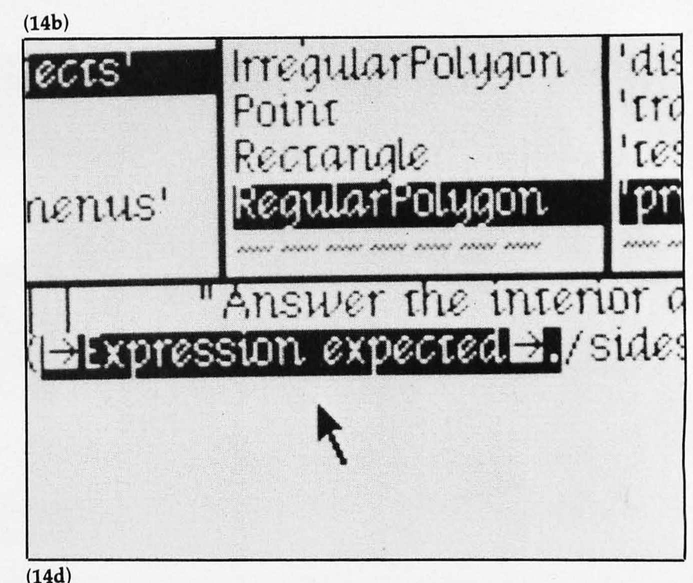
*CP/M is a trademark of Digital Research Corp.

When you are done editing, pop up the active-pane menu and issue the "compile" command (photo 14a). Compilation takes a few seconds or less because it is *incremental*—that is, you can compile one method at a time. The compiler reports a syntax error to you by inserting a message at the point where the error was detected and automatically selecting that error message (photo 14b). You can then cut out or overtype the message, make the correction, and immediately reissue the "compile" command.

If you start to revise a definition and change your mind about it, you can pop up the pane menu and issue the

(14a)

(14b)



(14c)

(14d)

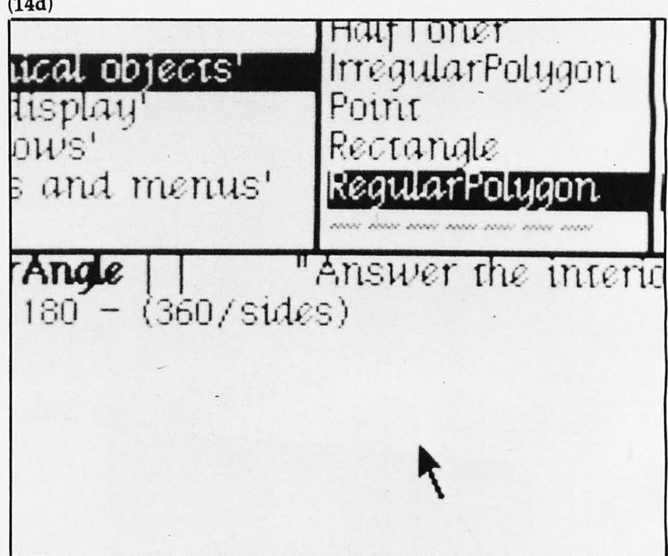


Photo 14: *Options during method compilation.*

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"cancel" command (photo 14c). The "cancel" command *redisplays* the last successfully compiled version of the method (photo 14d). If you cancel by accident, just issue the "undo" command to return the revised version.

Adding New Definitions

To add a new method definition, select a method category. In the editing pane, a *template* appears for defining a new method (photo 15a). The template reminds you of the required syntax of a method.

Use standard editing facilities to supply the message pattern, variable list, and body of the method. When the definition is ready, issue the "compile" command (photo 15b).

Once compilation succeeds, the selector of the new method is automatically added to the alphabetized list in the method pane, and the message pattern is automatically changed to boldface in the editing pane (photo 15c).

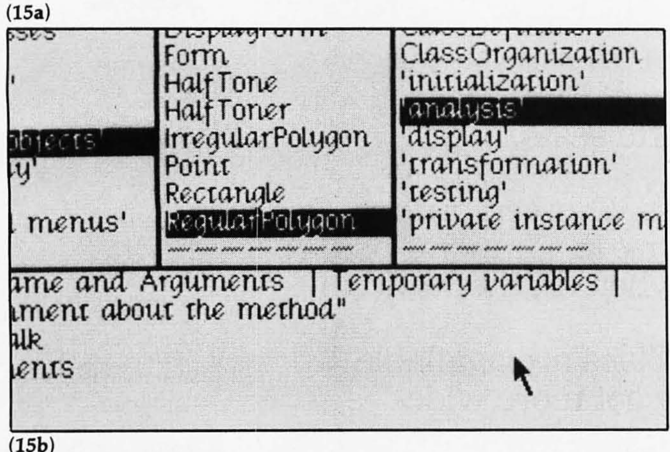
A new class definition is added in an analogous manner. Start by selecting a class category (photo 15d), then fill in a template for defining a new class and compile it (photo 15e). New categories can be added and old categories can be renamed and reorganized.

Program Testing

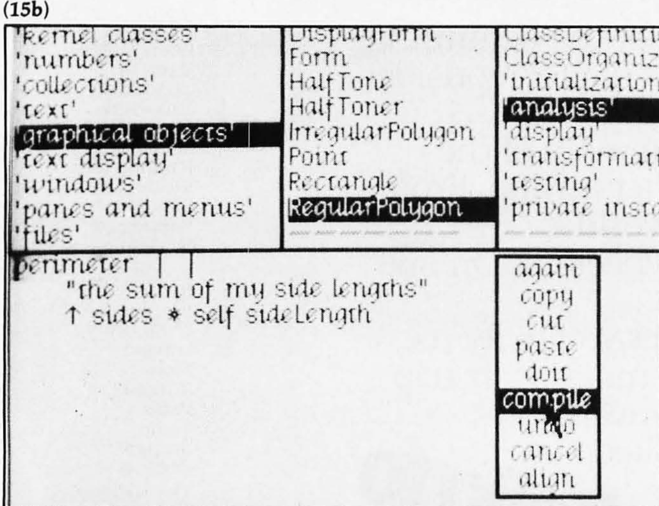
Let us purposely add a bug to a method and see how it can be tracked down and fixed.

Browse to the method cornerAngle in class RegularPolygon, cut out the characters "180 —" (photo 16a), and recompile it. In the RegularPolygon work-space window, select the test program and issue the "do it" command (photo 16b). Instead of the desired triangle, an open three-sided figure is drawn because of the bug introduced into the angle calculation.

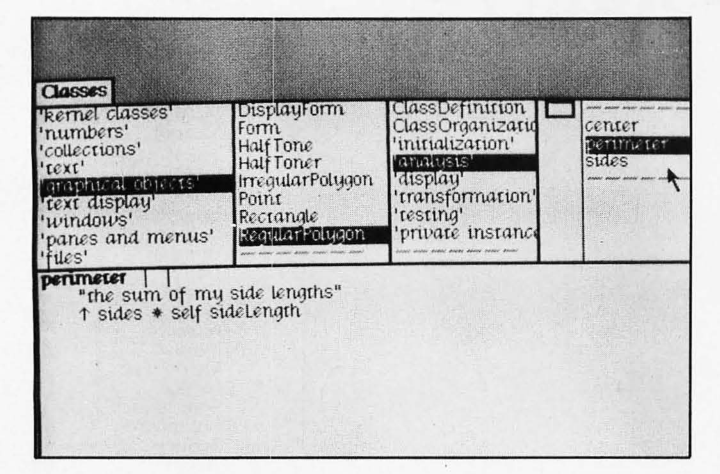
(15a)



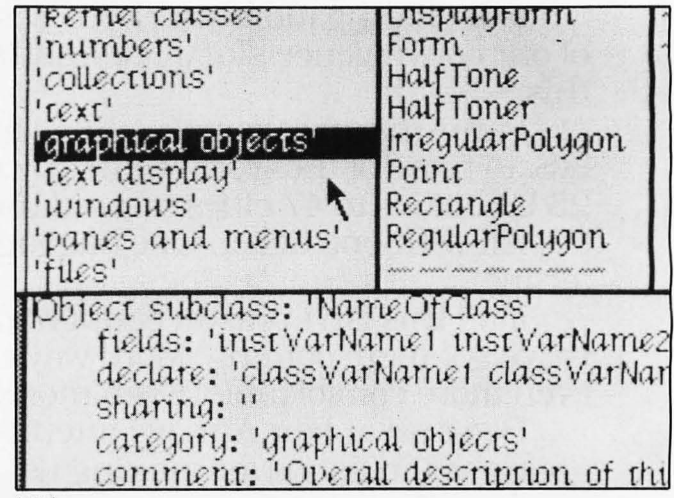
(15b)



(15c)



(15d)



(15e)

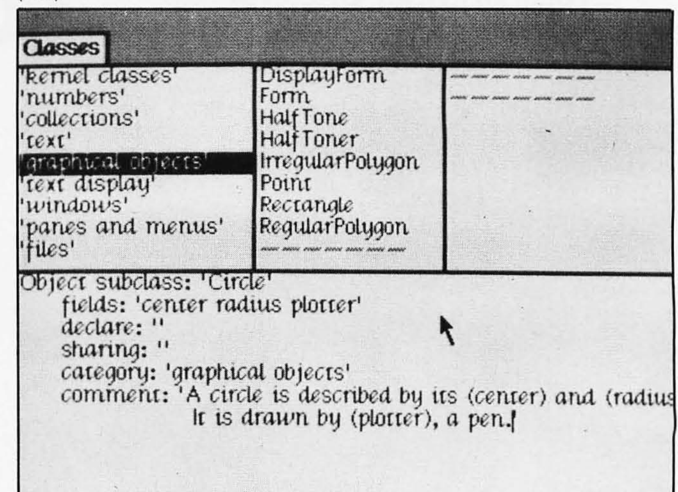


Photo 15: *Adding new definitions in Smalltalk.*

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Breakpoints

To track down the bug, let us set a breakpoint in the method cornerAngle. Using standard editing facilities, add the statement:

self notify: 'about to calculate angle'.

before the return statement (photo 16c). Now rerun the test case. When the computer encounters the breakpoint, a new window appears in midscreen. It is called a "notify window" (photo 16d). The title tab of the notify window says "about to calculate angle".

The notify window has one pane, the *stack pane*. It shows RegularPolygon>>cornerAngle (ie: the class and method in which the breakpoint was encountered). The pop-up menu of that pane offers several commands, including "stack" and "proceed" (photo 16e).

The "proceed" command closes the notify window and continues execution from the breakpoint. If we issue a "proceed" in our example, the same breakpoint will be encountered again immediately because the cornerAngle method is used several times during the execution of the test program.

What a Notify Window Can Display

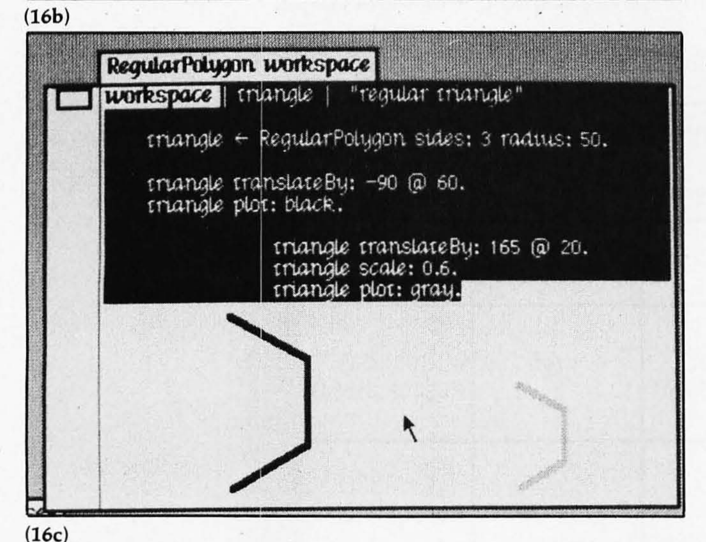
The "stack" command expands the contents of the pane to include messages that have been sent, but have not yet received replies (photo 17a). It reveals that the sender of the message cornerAngle was RegularPolygon>>plot:.

The pop-up menu of the notify window offers the usual repertoire, including the "close" and "frame" commands (photo 17b). If "close" were issued, the notify window would disappear from the screen and execution of the

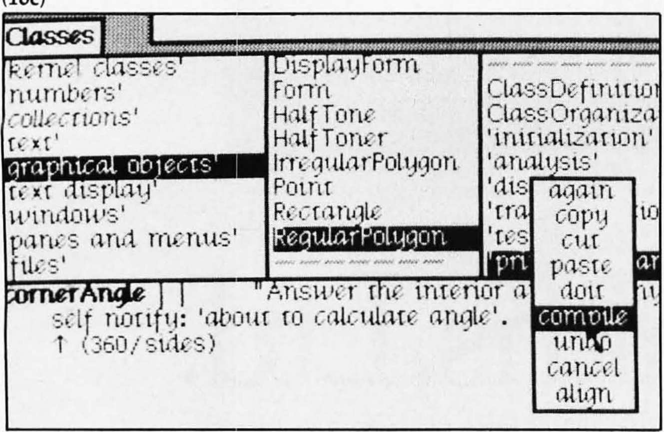
Text continued on page 138

(16a)

(16b)



(16c)



(16d)

(16e)

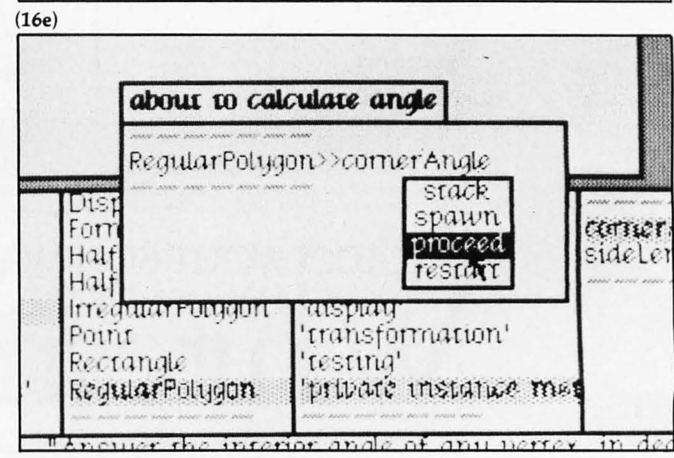


Photo 16: *Creating a faulty method for purposes of illustration.*

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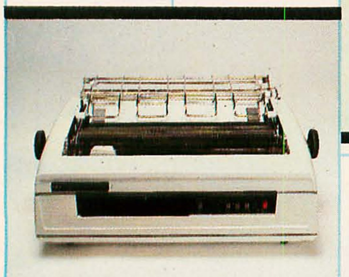
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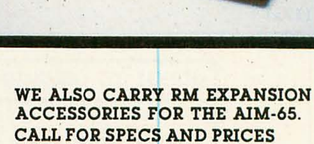
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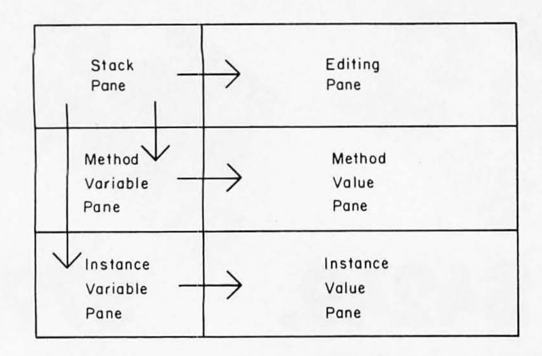


Figure 5: *Principal dependencies among panes of a notify window.*

Text continued from page 134:

program under test would be aborted. Let us issue the "frame" command instead. The notify window grows larger and acquires a total of six panes (photo 17c). Their interdependencies are diagrammed in figure 5.

The upper left pane is the stack pane retained from before. The upper right pane is an editing pane. If you select RegularPolygon >> plot: in the stack pane, its method definition appears in the editing pane. You can scroll through the definition and even edit it there and recompile as in the browser.

The middle two panes are the "context variable" and "context value" panes. They are analogous to the two panes of an inspect window, but, in this case, the variables you can examine are the arguments and local variables of the method selected in the stack pane. Click ink in the variable pane to see its value in the value pane.

The bottom two panes are the "instance variable" and "instance value" panes. They also are analogous to the panes of an inspect window. They let you examine the instance variables of the receiver of the message selected in the stack pane. Click center to see its value appear in the value pane.

You can type statements into the value panes and execute them using "do it" (photo 17d). They will be executed in the context of the method selected in the stack pane—that is, they may refer to arguments and local variables of the method and to instance variables.

Debugging

You could step through the execution of the method in the editing pane. You would select one statement at a time in the editing pane and issue the "do it" command. To close in on the planted bug, we can evaluate self cornerAngle, an expression on the last line of the method. Select that expression and issue the "do it" command (photo 18a). The answer, 120, appears to the right of the question (photo 18b). Since the interior angle of a regular

(17a)

(17b)

(17c)

(17d)

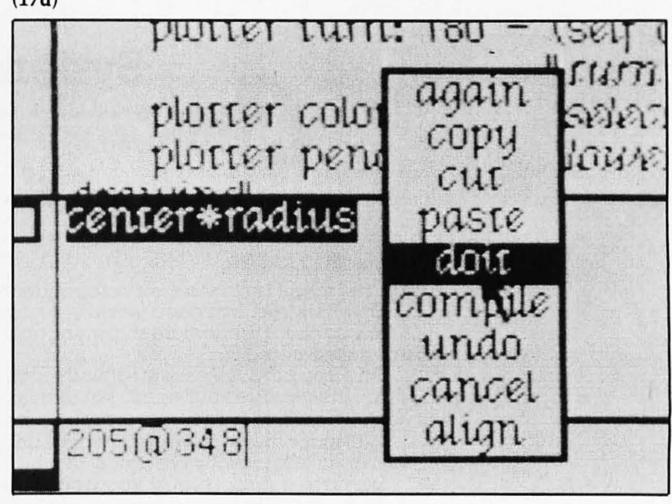


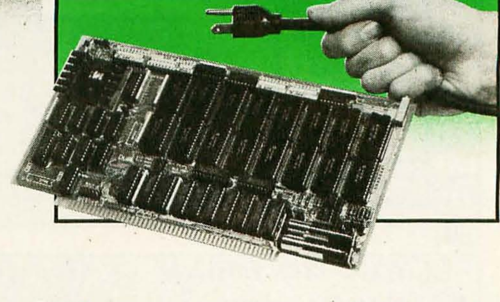
Photo 17: *Use of the "notify" window.*

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(18a)

(18b)

(18c)

(18d)

Photo 18: *Debugging a faulty method.*

triangle is 60 degrees, we have found the planted bug.

Now select *RegularPolygon>>cornerAngle* in the stack pane. Its method definition, including the breakpoint we set, appears in the editing pane (photo 18c). Use standard editing to remove the breakpoint, correct the error, and recompile the editing pane (photo 18d).

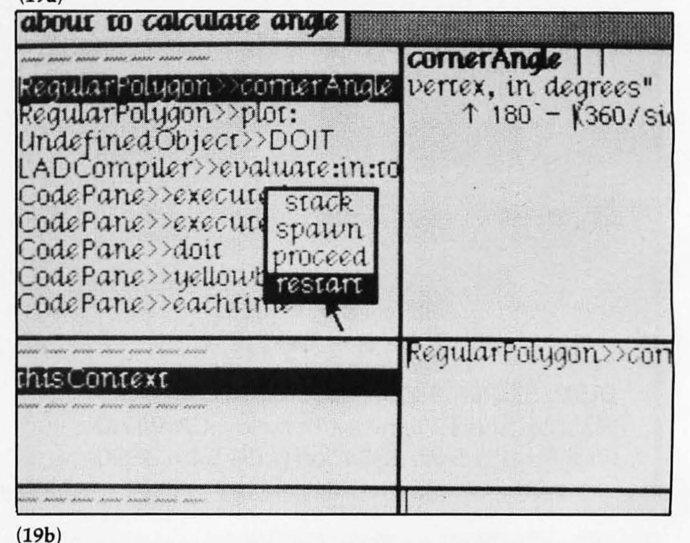
You can randomly access any level in the stack by clicking it in the stack pane.

Resumption

After recompiling a method, you can resume execution from the beginning of any method on the stack using the "restart" command in the stack-pane menu (photo 19a). This lets the test proceed (photo 19b) without having to start over from the work-space window. Resumption of execution after a correction is a handy capability when a program that has been running well encounters a minor bug.

The entire stack of the process under test was saved in the notify window. When a notify window appears, the rest of the system is not preempted. You are not required to deal with the notify window when it appears. You can

(19a)



(19b)

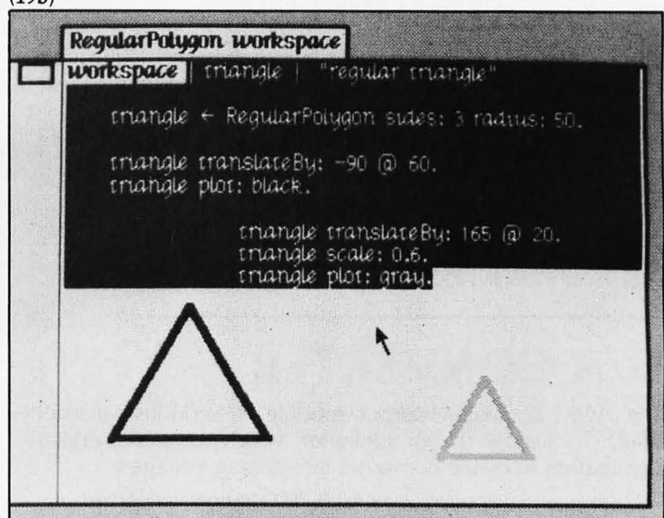


Photo 19: *Compilation of a faulty method can be continued without restarting, once the error has been corrected.*

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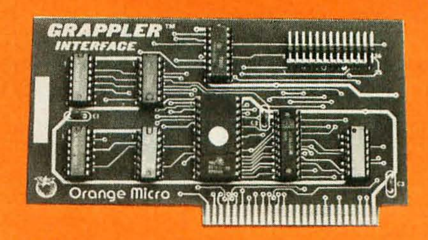
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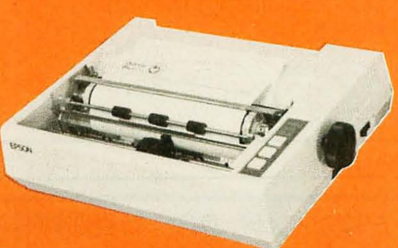
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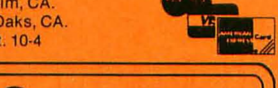
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work in other windows and come back to it later, cause other notify windows to be created, or work a little in the notify window and then do something else. There are no modes.

Error Notifications

Error messages are no different from breakpoints, except that if they are supposed to be "unrecoverable" they are programmed as:

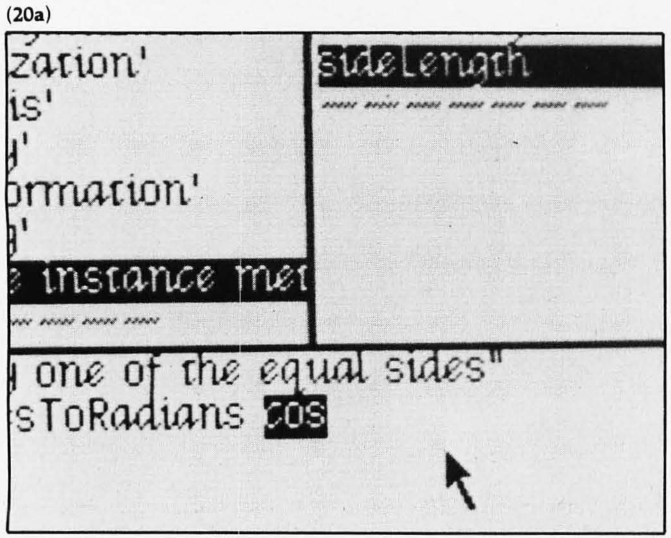
```
self error: 'error whatever'.
```

If the user "proceeds" out of the notify window after an error, the process under test is terminated.

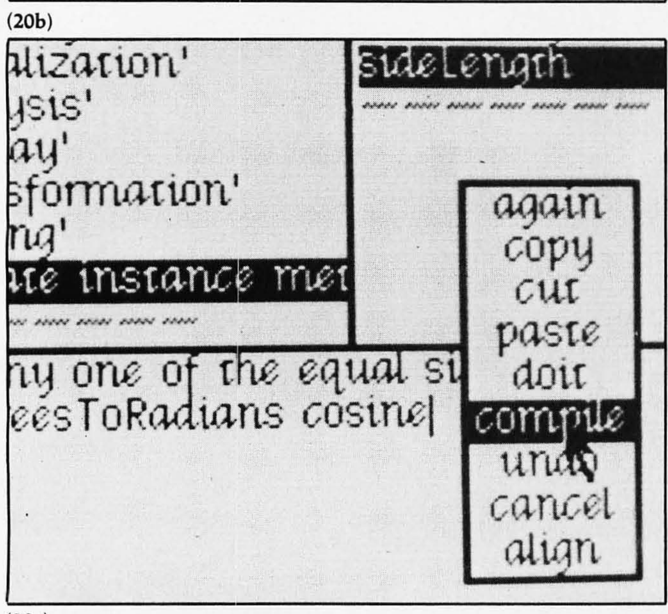
The most frequently encountered Smalltalk error is "Message not understood." It occurs when a method is sent to an object and neither that object's class nor any of its superclasses defines a method to receive that message. Let us edit the method sideLength (photo 20a) to send the message cosine instead of cos. After recompiling that method (photo 20b) and reexecuting the test program, a notify window appears (photo 20c) to announce that class Real and its superclasses do not define cosine.

In most programming systems, equivalent error conditions such as "undeclared procedure" and "wrong number of arguments" are issued at compile time. Smalltalk cannot detect these conditions until run time because variables are not declared as to type. At run time, the object sent the message cosine could be an instance of a class that did define a method of that name.

(20a)



(20b)



(20c)

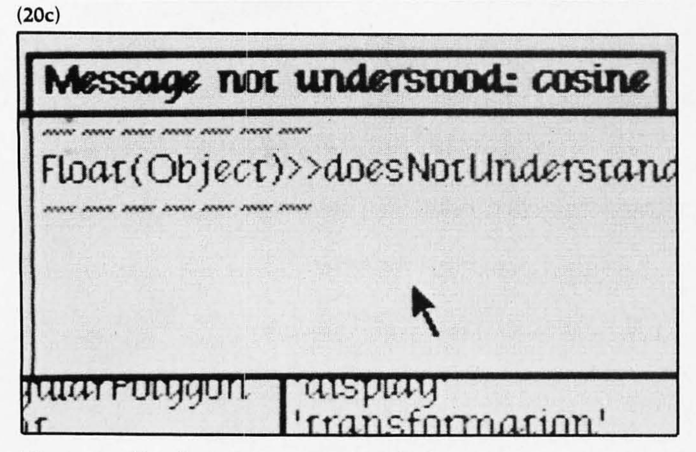


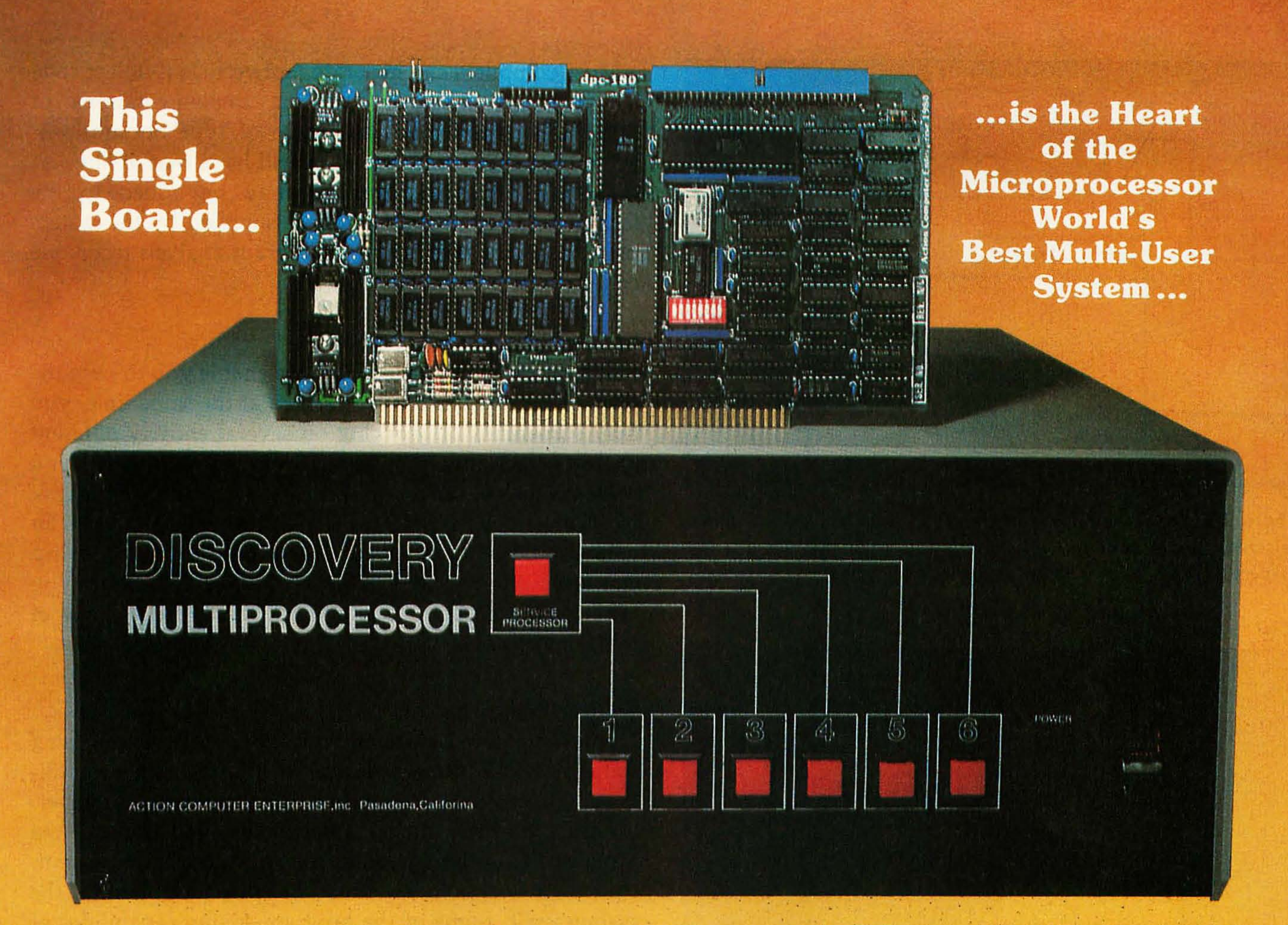
Photo 20: *Displaying an error in a faulty method.*

Type Checking

When we program in languages like Pascal, we depend on type checking to catch procedure-call errors early in the software-development process. In return, we have to take extra time maintaining type declarations, and we lose the very powerful ability to define "generic" or "polymorphic" procedures with the same name but with parameters of varying types.

Type checking is important in most systems for four reasons, none of which is very important in Smalltalk:

- Without type checking, a program in most languages can "crash" in mysterious ways at run time. Even with type checking, most programming systems can crash due to uninitialized variables, dangling references, etc. Languages with this feature are sometimes called "unsafe." Examples of unsafe languages are Pascal, PL/1, and C. Examples of fairly safe languages are BASIC and LISP. Smalltalk is a safe language. It cannot be wiped out by normal programming. In particular, it never crashes when there are "type mismatches." It just reports a "Message not understood" error and helps the programmer quickly find and fix the problem through the notify window.
- In most systems, the edit-compile-debug cycle is so tedious that early error detection is indispensable. In Smalltalk, type errors are found early in testing, along with value-range errors and other bugs.
- Type declarations help to document programs. This is true, but well-chosen variable names and pertinent comments provide more specific information than do type declarations. A poor documenter can convey as little information in a strongly typed program as in an untyped program.



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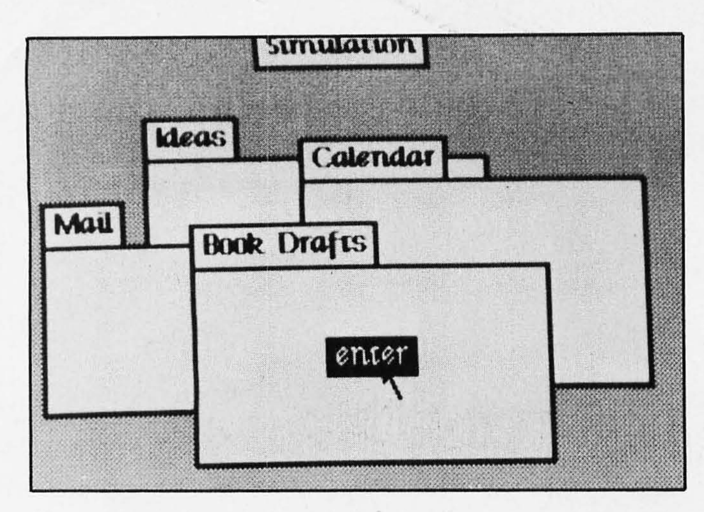
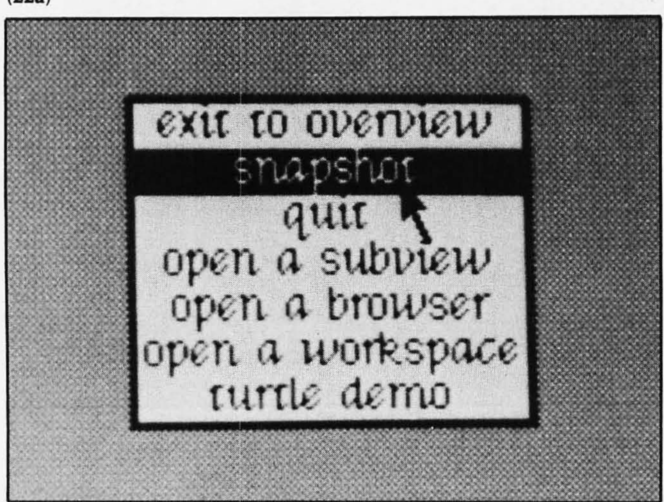


Photo 21: *Project windows in Smalltalk. Each window, when selected, makes available all the windows associated with that project.*

(22a)



(22b)

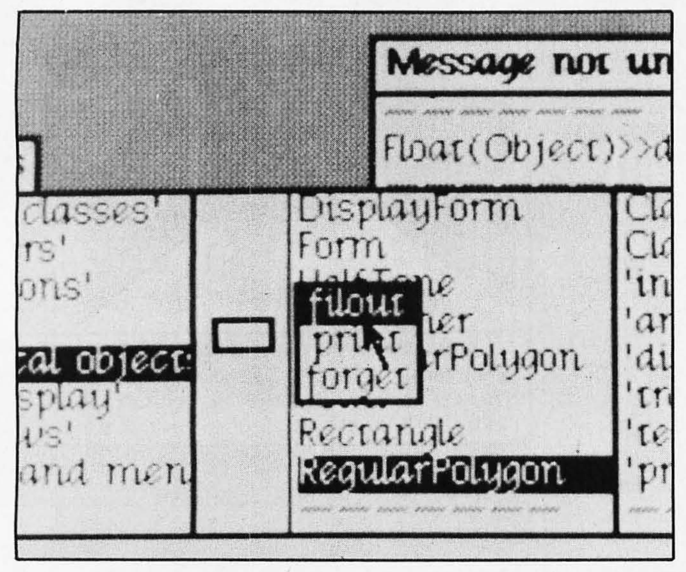


Photo 22: *Recording results in Smalltalk. The current state of the Smalltalk system can be saved with "snapshot." Smalltalk code can be saved to a text file by using "filout" and restored by using "filin."*

•Most compilers can generate more efficient object code if types are declared. Existing implementations of Smalltalk cannot take advantage of type declarations. We expect that future versions will have that ability. At that time, type declarations may be added to the language. They probably will be supplied by the system rather than the user, using a program-analysis technique called "type inference."

Project Windows

Although overlapping windows enable you to keep the state of several tasks on the screen at the same time, you may sometimes be working on several entirely different *projects*, each involving several tasks. Smalltalk lets you have a different "desk top" for each project. On each desk top are windows for the tasks involved in that project. To help you travel from one desk top to another, a desk top can have one or more *project windows* that show you other available desk tops and let you switch to one of them (photo 21).

Saving Programs

In unintegrated systems, you create a program using standard text-editing facilities. Then, using standard utility programs, you can obtain a program listing on paper, back up the program on other media, and transmit the program to other people. In an integrated system, equivalent capabilities must be provided within the system itself. Some of the program-saving capabilities of Smalltalk are described briefly below.

One important facility is the *snapshot* (photo 22a). The entire state of the Smalltalk environment—including class and method definitions, data objects, suspended processes, windows on the screen, and project desk tops—can be momentarily frozen and saved on secondary storage. The snapshot can be restored later and resumed. People familiar with the *sysout* in InterLISP or the *workspace* concept in APL will understand the benefit of this facility.

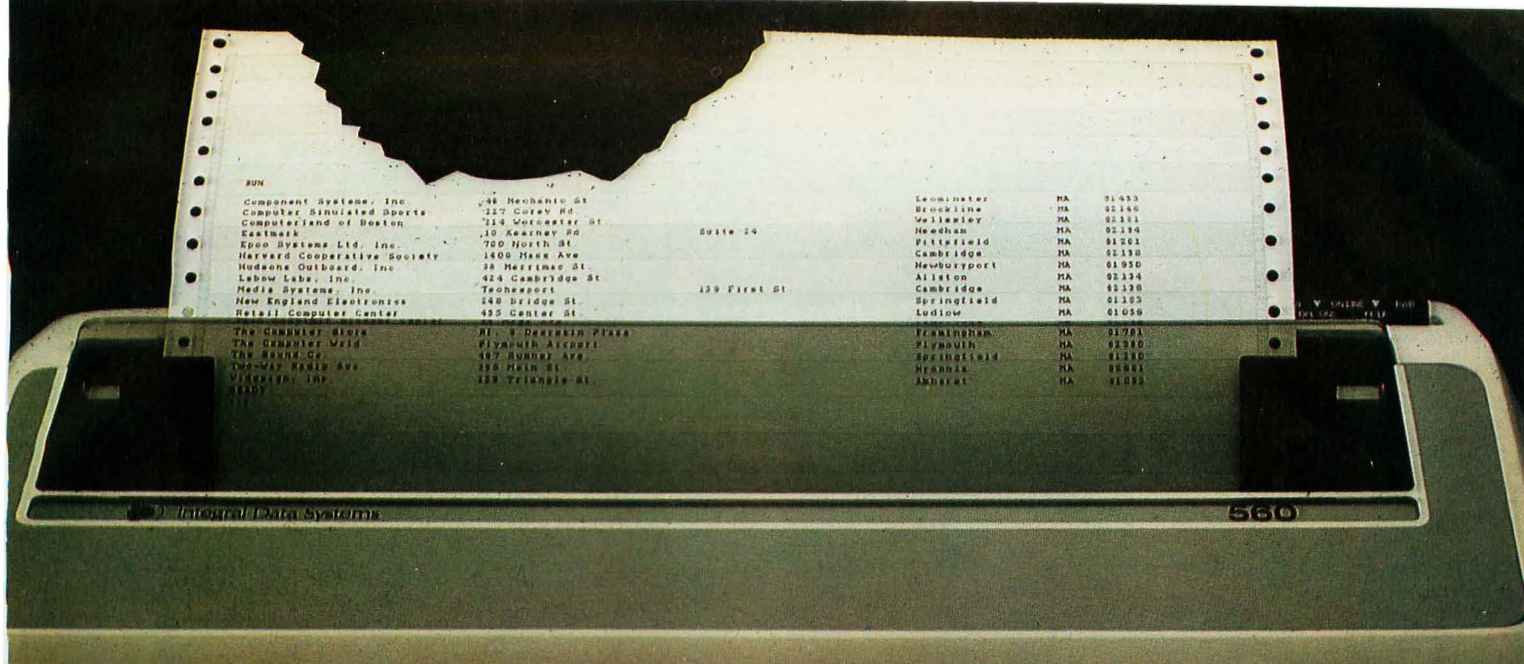
Another facility allows definitions of one or more methods or classes to be listed on a printer. A related facility is *filin/filout*. The *filout* message (photo 22b) writes an ASCII representation of one or more definitions onto a conventional text file. The definitions can then be transfused into another Smalltalk environment by using the *filin* message in that environment.

Often, during a programming session, the user changes a number of method definitions that are scattered throughout many classes and cannot recall which ones were changed. The *changes* facility automatically keeps a record of what definitions changed in each project, and makes it easy for the user to *filout* those definitions at the end of the session.

Implementation of the Environment

Because Smalltalk is an integrated environment, all the facilities described in this article are implemented in the

Text continued on page 147



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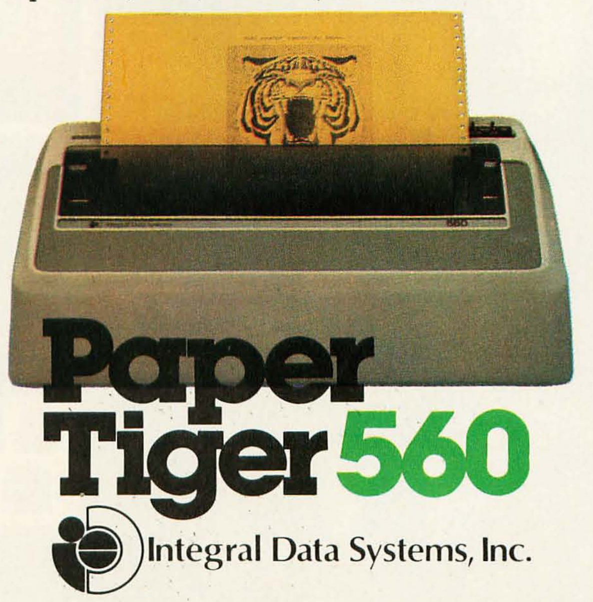
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Text continued from page 144:

high-level language, including modeless editing, windows, the compiler, and the notify mechanism. This was possible because Smalltalk represents everything, including the dynamic state of its own processes, as objects that remember their own state and that can be sent messages by other objects. Using the browser, you can examine and (carefully) change the definitions of the software-development aids.

In the implementation of Smalltalk-76, classes InspectWindow, BrowseWindow, and NotifyWindow are all tiny subclasses of class PanedWindow, which defines their common behavior. Similarly, classes StackPane, VariablePane, ValuePane, and so on, are all tiny subclasses of class ListPane. The superclass defines common behavior such as scrolling and selecting entries.

If someone shows you a system claimed to be "Smalltalk," find out whether the software-development aids exist and whether they are programmed as class definitions in the high-level language. If not, the system is *not* bona fide.

Conclusions

The Smalltalk programming environment is *reactive*. That is, the user tells it what to do and it reacts, instead of the other way around. To enable the user to switch between tasks, the state of the tasks is preserved in instantly accessible windows that overlap on desk tops. To give the user the maximum freedom of choice at every moment, modes rarely occur in the user interface. The result of this organization is that tasks, including software-development tasks, can be accomplished with greater speed and less frustration than is usually encountered in computer systems. ■

References

1. Sneeringer, J. "User-Interface Design for Text Editing: A Case Study." *Software—Practice and Experience 8*, pages 543 thru 557, 1978.
2. Swinehart, D C (thesis). "Copilot: A Multiple Process Approach to Interactive Programming Systems." *Stanford Artificial Intelligence Laboratory Memo AIM-230*, Stanford University, July 1974.
3. Kay, A and A Goldberg. "Personal Dynamic Media." *Computer*, March 1977 (originally published as *Xerox PARC Technical Report SSL-76-1*, March 1976, out of print).
4. English, W, D Engelbart, and M Berman. "Display-Selection Techniques for Text Manipulation." *IEEE Transactions on Human Factors in Electronics*, volume 8, number 1, pages 21 thru 31, 1977.
5. Card, S, T Moran, and A Newell. "The Keystroke-Level Model for User Performance Time with Interactive Systems." *Communications of the ACM*, volume 23, number 7, July 1980.
6. Goldberg, A and D Robson. "A Metaphor for User-Interface Design." *Proceedings of the Twelfth Hawaii International Conference on System Sciences*, volume 6, number 1, pages 148 thru 157, 1979.
7. Borning, A. "ThingLab—A Constraint-Oriented Simulation Laboratory." To appear in *ACM Transactions on Programming Languages and Systems* (originally published as *Stanford Computer Science Report STAN-CS-79-746* and *Xerox PARC Technical Report SSL-79-3*, July 1979, out of print).

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User-Oriented Descriptions of Smalltalk Systems

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Central Institute for Industrial Research
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Norway

For many people, the workings of a computer remain a mystery. Just exactly what the computer does and how it does it is locked within the code of a computer language. The computer and the user understand two completely different languages. It is well known that only a few systems are designed and written so that they can be understood by the user. More than twenty years of experience has shown that a bad system design can never be hidden from the user, even by a masterfully devised user interface. A quality system, therefore, must be based on sound design that can be described in terms with which the user is familiar.

The Smalltalk system has been designed to handle a great variety of problems and solutions. It, therefore, provides the greatest possible flex*ibility* for writing any kind of system a programmer may desire. While this flexibility is essential for experimenting, there is the potential for disastrous results if restrictions are not put on the system structures that are available to the application programmer.

This article shows how the basic metaphors of Smalltalk can be used to describe complex systems. Since this magazine is not yet distributed in a form readable by Smalltalk, we have to restrict ourselves to traditional written documentation. (Let it be a challenge to Smalltalk experimenters to convert this presentation into a graphic and dynamic one.)

The Smalltalk system user will most likely employ his system to organize the large amount of information that will be available to him,

More than twenty years of experience has shown us that a bad system design can never be hidden from the user, even by a masterfully devised user interface.

such as reference materials in the form of market information, news services, and weather forecasts. Some data, such as travel information and bank transactions, may flow both to and from the owner. Other information, such as personal notes or material that is not yet ready for distribution, can remain private.

An individual's total information needs are very large and complex. His Smalltalk system, therefore, is also likely to be large and complex. The challenge to the Smalltalk experimenter is to find ways to structure systems so the user will not only understand how to use them, but also get an intuitive feel for their inner workings. In this way, the user can really be the master and the systems his faithful slaves.

An important part of any system is the software that controls the user's interaction with the information. Mastering the software is crucial to handling the information. With Smalltalk, software is just a special kind of information and is treated as any other information within the total system. It is available to the user in the usual manner.

A traditional way of describing software is through written documentation. Smalltalk provides more dynamic interfaces through the use of two-dimensional graphics and animation on the computer screen. Devising such interfaces is probably the greatest challenge in personal computing today, and it provides a rich field of endeavor for the interested experimenter.

System Descriptions

We can describe any application system in three different ways: *how it is used, its system structure,* and *its implementation*:

- *How it is used*—This is the least satisfactory type of description. The user operates the system through rote command sequences such as: *switch on the machine, type your password, hit button A, listen to your system saluting you by playing "Hail to the Chief."* Since 80% of all user manuals for electronic data processing systems

are of this kind, we will not discuss them further here.

This level of understanding has been likened to walking around in a strange city following directions such as: "Go outside, turn right, walk straight ahead for four blocks, turn left . . . . " It is easy to get lost under such circumstances.

• *System structure*—With this type of description, the user has an intuition about the kinds of building blocks that make up the system, how they behave, and how they interact to form the complete system. We show that the basic Smalltalk metaphors of *objects* and *messages* are well suited to function as building blocks. The metaphors are simple and easy to understand; yet they permit construction of immensely powerful systems.

A basic system will have several thousand objects, and typical applications would contain many more.

Any Smalltalk system contains a large number of objects. A basic system will have several thousand objects, and typical applications would contain many more. The common software engineering device of *layering* becomes essential in making the whole thing manageable. In the description of a layer, essential function on that level is highlighted and inconsequential detail is relegated to lower levels. There is one absolute requirement of these simplified descriptions appearing on the different layers: *what is shown should be correct and complete as far as it goes.* This means that the structure of the description has to be a pure tree structure: the function of each module has to be limited to that module with *no hidden side effects upon the other modules.*

This level of understanding corresponds to the user having a street map of the system. He knows the major landmarks and the most important streets. This gives the user an intuition about the total structure and permits him tc find his way anywhere. It is almost impossible to get totally lost under these circumstances.

• *Implementation*—Descriptions at this level of understanding explain to the user how each individual object is built so that it behaves in the manner prescribed on the system structure level. Here he will find the third basic metaphor of Smalltalk, the *method.* A method is similar to a subroutine in other languages; it prescribes the actions to be taken by an object when it receives a message.

On all layers but the lowest, the behavior of an object is fairly complex, and we can think of it as composed of a number of *sub-objects* that are used to implement it. The purpose of the method is to enlist the aid of the sub-objects to implement the desired behavior. The user thus finds that the typical object is structured in much the same manner as his total system, and it consists of a number of sub-objects that send messages to each other. The description tool is recursive in that the same tool is used on all levels. This recursion description is probably the most powerful feature of Smalltalk. Once the user masters the few very general concepts, he can learn more and more about his system by simply using these concepts to dig deeper and deeper into the system layers. In addition, the user can modify and expand the system on any level by collecting new components out of the building blocks provided by the next level below it.

The user at this level now has an intuition of the overall layout of the city. He also has sub-maps of all the details and he knows how to read them. Depending on his personality, he may use these maps only when absolutely necessary, or he may use them to explore unknown territory. In contrast to the tourist, the Smalltalk user can even make modifications and new extensions to the city. The tools are there. The user decides if, when, and how he wants to use them.

Example of a System Description

The problem: Consider a small manufacturing company that has two

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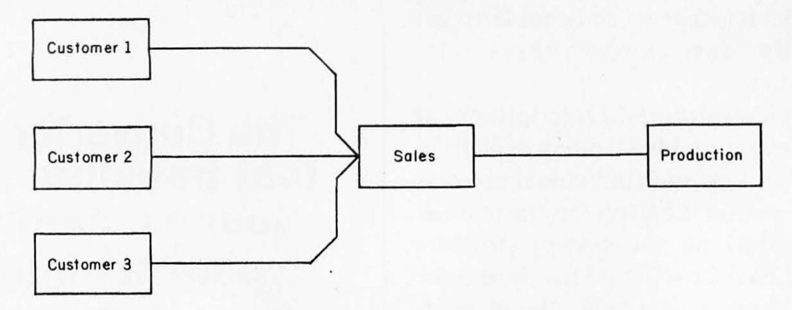


Figure 1: *A job-shop manufacturing company with its customers.*

departments: sales and production. The responsibility of the sales department is to find customers for any product the company can make, to contact the production department to find out when the product can be delivered, and to sign a contract with the customer. The responsibility of the production department is to manufacture each product as cheaply as possible at a specified level of quality and to have it finished on the promised date. When the production department has manufactured the product, it is dispatched to the customer through the sales department.

The system: A natural way to map this into a Smalltalk system would be to represent each department as an object. The function of the Sales object would be to keep track of the state of each sale in the following sequence:

1. Fill in and send proposals
2. Reserve the necessary resources in production for the product
3. Send contracts and packing notes to the customer

The function of the Production object would be to:

1. Keep track of commitments
2. Schedule the manufacture of products
3. Help keep the product quality
4. Control the manufacturing process to get the products completed on time

It also seems reasonable to include a third kind of object in our system: Customer objects. The purpose of these objects would be to act as a receptacle for the messages being passed from the company to the customer and from the customer to the company. The various objects with a set of reasonable communication channels is shown in figure 1.

The overall processing of an order: The Smalltalk system would be programmed to reflect everything of importance that takes place during the processing of an order and to support its user on every step. The process that takes place inside the Smalltalk system would, therefore, closely resemble the actual processing of an order. Let us assume the following real-life process, which is depicted in figure 2. A customer submits an intention to buy, a request for offer, to the company. The sales department books resources from the production department and returns an offer with the cost and delivery date to the customer. The customer answers with a purchase order. This is transcribed and passed from sales to production as a requisition. The product is manufactured in production, and a ready-note is sent to sales, which arranges for transport and sends packing notes to the customer.

In the Smalltalk system, the Sales object would help the user of the system in corresponding with the customer, in keeping track of progress, and in sending the required forms to the production department. The Production object would help the user in the planning and control of the manufacturing process.

In order to highlight the principles, we have made this a very simple system. The reader will have no difficulty in expanding it, for example, by adding an object for the accounting department that takes care of bill-

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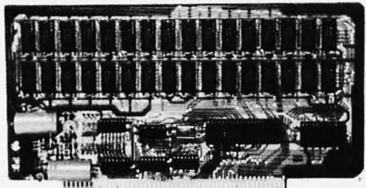
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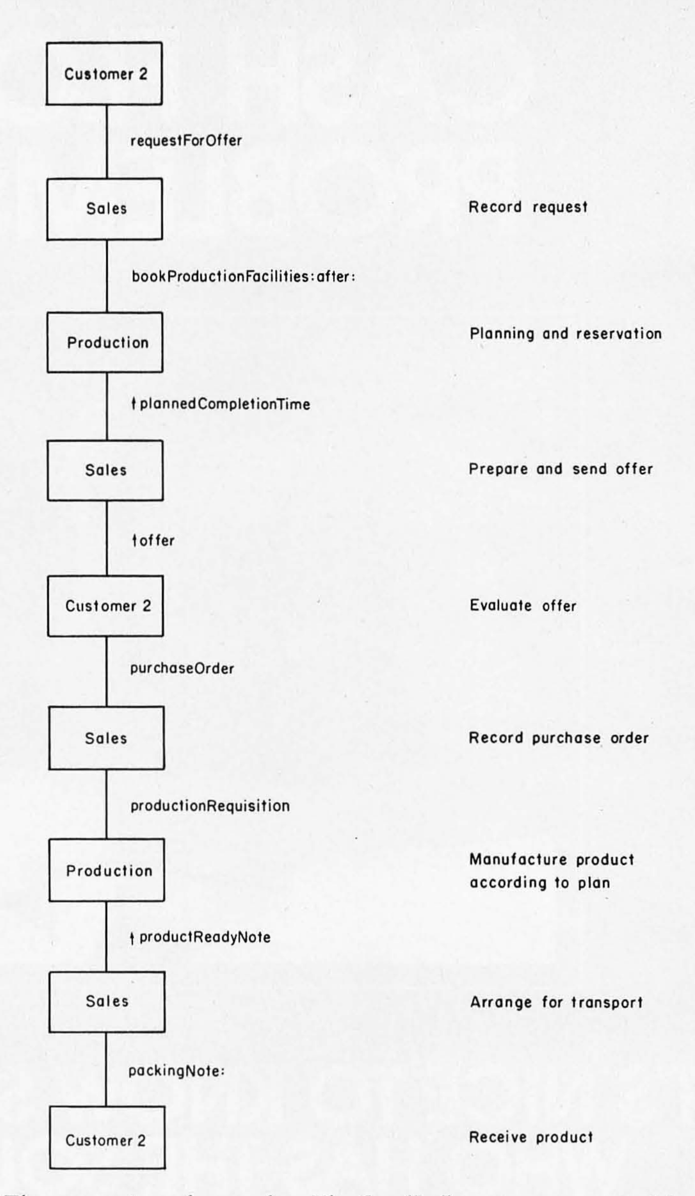


Figure 2: *The processing of an order. The Smalltalk system supports this processing through interaction with its owner in real-time.*

ing, an object for the warehouse that may or may not have the required product in stock, and so on. Also, figure 2 could probably be better documented on a Smalltalk computer by animating figure 1.

An Implementation Description

Let us inspect the Production object of figure 1 and see how it processes the message bookProductionFacilities: after:. When this message is received by the Production object, it consults its message dictionary to find the corresponding method. If the products were simple and the workshop small, the object could contain the current production plan directly and the method could go something like that shown in listing 1.

One of the instance variables of the Production object is the table productDuration which contains the time it takes to manufacture various products. Looking at this table, we find the duration for a product. In this simple example, there is only one resource, and we find the first available time slot for the product by sending self the message findFreePeriod: after:. This corresponds to calling a local subroutine in other systems. We then reserve the resource for our product in that period. (These two steps could have been combined into one, but the separation gives us more flexibility in varying the planning algorithm if we wish to do so later.)

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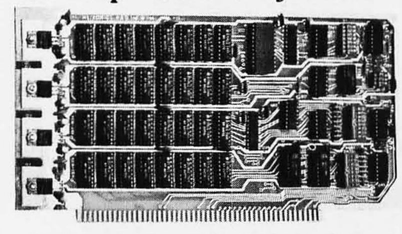
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Listing 1: *Smalltalk method for the message* bookProductionFacilities:after:.

```
bookProductionFacilities: productType after: earliestStartTime
    "Reserves production facilities for a new product of given type as soon as possible after the
     specified earliest starting time. Returns the planned completion time for the product."
    | duration plannedStartTime |
    duration ← productDuration at: productType.
    plannedStartTime ← self findFreePeriod: duration after: earliestStartTime.
    self reservePeriod: duration from: plannedStartTime.
    ↑ (plannedStartTime + duration)
```

Listing 2: *Alternate Smalltalk method for the message* bookProductionFacilities:after:.

```
bookProductionFacilities: productType after: earliestStartTime
    "Reserves production facilities for a new product of given type as soon as possible after the
     specified earliest starting time. Returns the planned completion time for the product."
    | productIdentification |
    productIdentification ← jobManager defineProduct: productType.
    jobManager schedule: productIdentification after: earliestStartTime.
    ↑ (jobManager plannedCompletionTime: productIdentification).
```

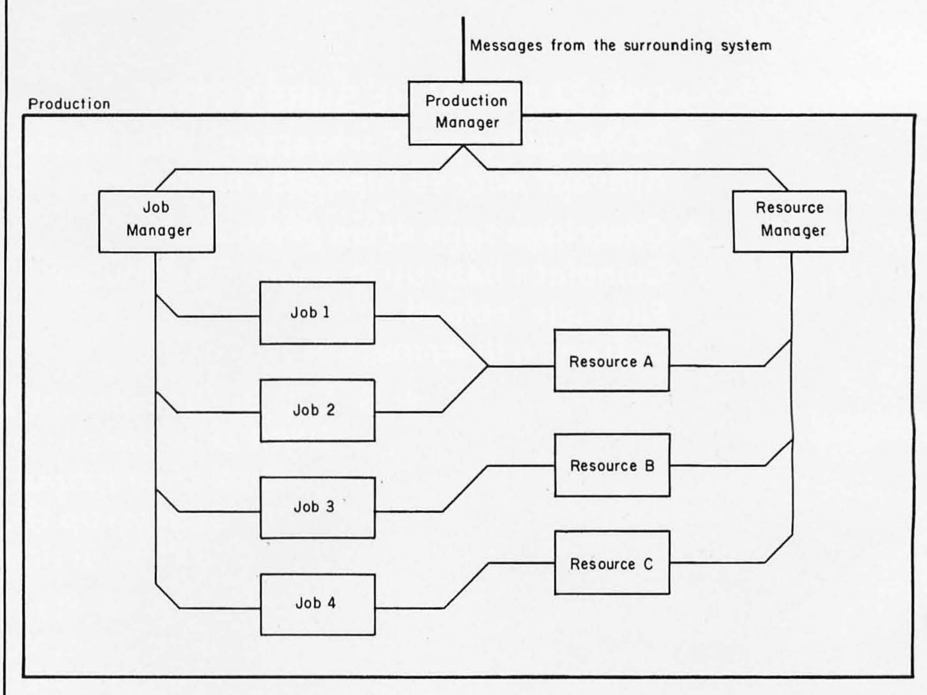


Figure 3: *The internals of the Production object.*

The planned completion time is returned to the sender, in this case the Sales object.

Lower-Level System Description

If the user wants more advanced aids for production control, the Production object would call upon the services of a subsystem of interconnected objects. A possible subsystem is shown in figure 3.

The entrance to the internals of the Production objects is through a Production Manager object; it is connected to a Job Manager object and a Resource Manager object.

The manufacturing of a product is split into a number of jobs. The available production facilities (people and machines) are split into a number of resources. Each job is to be performed by a single resource. A natural way to map this into a Smalltalk system is to represent each job by a Job object and each resource by a Resource object.

In this scheme, each Job object ensures that the job is performed by its

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resource within the available time. Similarly, each Resource object ensures that its resource is used in an efficient manner, that there is sufficient time available for preventive maintenance, and that there are no unacceptable overloads. The method in the Production object that handles the bookProductionFacilities:after: message could now be written as shown in listing 2.

One of the instance variables of the Production Manager object is a pointer to the Job Manager object. By using that pointer as a communication channel, the Production Manager object passes most of the work on to the Job Manager object. First, the Job Manager is asked to define the new product. The Job Manager creates the Job objects (see figure 3), links them to the proper Resource objects, and returns an identification that is to be used for future references to the product. The Job Manager is then asked to schedule the product for manufacturing as soon as possible after the given date. Finally, the Job Manager is asked when the product will be completed, and this value is returned to the outside world (in this case, to the Sales object). The planning process in the Production subsystem that is shown in figure 4 is controlled by this method.

Definition of New Objects

The first task of the Job Manager object is to define the new object. It receives message defineProduct: when this is to be done. The corresponding method could be something like that shown in listing 3. We are referencing two instance variables of the Job Manager object in this method: productDescriptions and productionManager. productDescriptions is an ordered collection with one member for each product type. Each of these members contains a sequence of small objects with the class, duration, and resource type for each of the jobs that go into the manufacture of such a product. productionManager contains a pointer to the Production Manager object. The result of the product creation is put into a third instance variable, the productDic-

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74162 — .60
74163 — .60
74164 — .60
74165 — .60
74166 — .70
74170 — 1.60
74173 — .75
74174 — .65
74175 — .60
74176 — .75
74177 — .75
74180 — .75
74181 — 1.90
74182 — .45
74190 — .70
74191 — .75
74192 — .70
74193 — .79
74194 — .85
74195 — .45
74196 — .75
74197 — .75
74279 — .60
74365 — .65
74367 — .65
74368 — .65
74390 — .90
75324 — 2.25
74325 — 1.50
75491 — 1.05
75492 — 1.05
8T98 — .20
9312 — .60
9601 — .75
9602 — .75

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200	.80	1.30	2.20
400	1.00	1.65	3.30
600	1.30	1.90	4.40

DIP SOCKETS
8 PIN .17
14 PIN .20
16 PIN .22
18 PIN .25
22 PIN .30
24 PIN .35
28 PIN .40
40 PIN .60

74LS SERIES

74LS00 — .18
74LS01 — .18
74LS02 — .20
74LS03 — .20
74LS04 — .22
74LS05 — .22
74LS08 — .20
74LS09 — .22
74LS10 — .20
74LS11 — .22
74LS12 — .22
74LS13 — .45
74LS14 — .40
74LS15 — .35
74LS20 — .18
74LS21 — .18
74LS22 — .25
74LS26 — .35
74LS27 — .28
74LS28 — .45
74LS30 — .18
74LS32 — .35
74LS37 — .30
74LS38 — .30
74LS40 — .40
74LS42 — .44
74LS47 — .65
74LS51 — .20
74LS54 — .20
74LS73 — .35
74LS74 — .35
74LS75 — .35
74LS76 — .45
74LS83 — .75
74LS85 — .85
74LS86 — .40
74LS90 — .45
74LS92 — .45
74LS93 — .45
74LS96 — .55
74LS109 — .38
74LS112 — .38
74LS113 — .45
74LS114 — .55
74LS123 — .65
74LS125 — .50
74LS126 — .50
74LS132 — .50
74LS136 — .45
74LS138 — .55
74LS139 — .55
74LS151 — .40
74LS153 — .40
74LS156 — 1.19
74LS157 — .55
74LS158 — .50
74LS160 — .70
74LS161 — .70
74LS162 — 1.00
74LS163 — .70
74LS164 — .70
74LS168 — 1.25
74LS169 — 1.75
74LS170 — 1.70
74LS173 — .65
74LS174 — .45
74LS175 — .40
74LS181 — 2.00
74LS190 — .80
74LS191 — .80
74LS192 — .70
74LS193 — .90
74LS194 — 1.10
74LS195 — .90
74LS196 — .85
74LS197 — .85
74LS221 — .80
74LS240 — .95
74LS241 — .95
74LS242 — .95
74LS243 — 1.00
74LS244 — 1.35
74LS245 — 1.50
74LS247 — .75
74LS248 — 1.10
74LS251 — .90
74LS253 — .55
74LS257 — .70
74LS258 — .60
74LS259 — 1.50
74LS266 — .45
74LS273 — 1.15
74LS279 — .50
74LS280 — 1.80
74LS283 — .80
74LS290 — .75
74LS293 — .40
74LS365 — .65
74LS366 — .65
74LS367 — .70
74LS368 — .70
74LS373 — 1.30
74LS374 — 1.35
74LS377 — 1.40
74LS386 — .50
74LS390 — 1.35
74LS393 — 1.25
74LS670 — 2.50
81LS98 — 1.10

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LM301/748 — .30
741CV — .35
741C — .35
747 — .50
1456 — .80
1458 — .50
4136 — .85
3900 — .45
LM307 — .30
LM308 — .75
LM324 — .65
LM339 — .65
LF355 — 1.25
LF356 — 1.35
LM311 — .50
LM318 — 1.00
LM348 — .90
LM358 — .50
LM361 — 1.75
LM377 — 1.60
LM380 — 1.25
LM382 — .80
LM383 — 2.50
LM386 — .80
LM387 — 1.25
LM553 — 2.25
LM555 — .45
LM556 — .85
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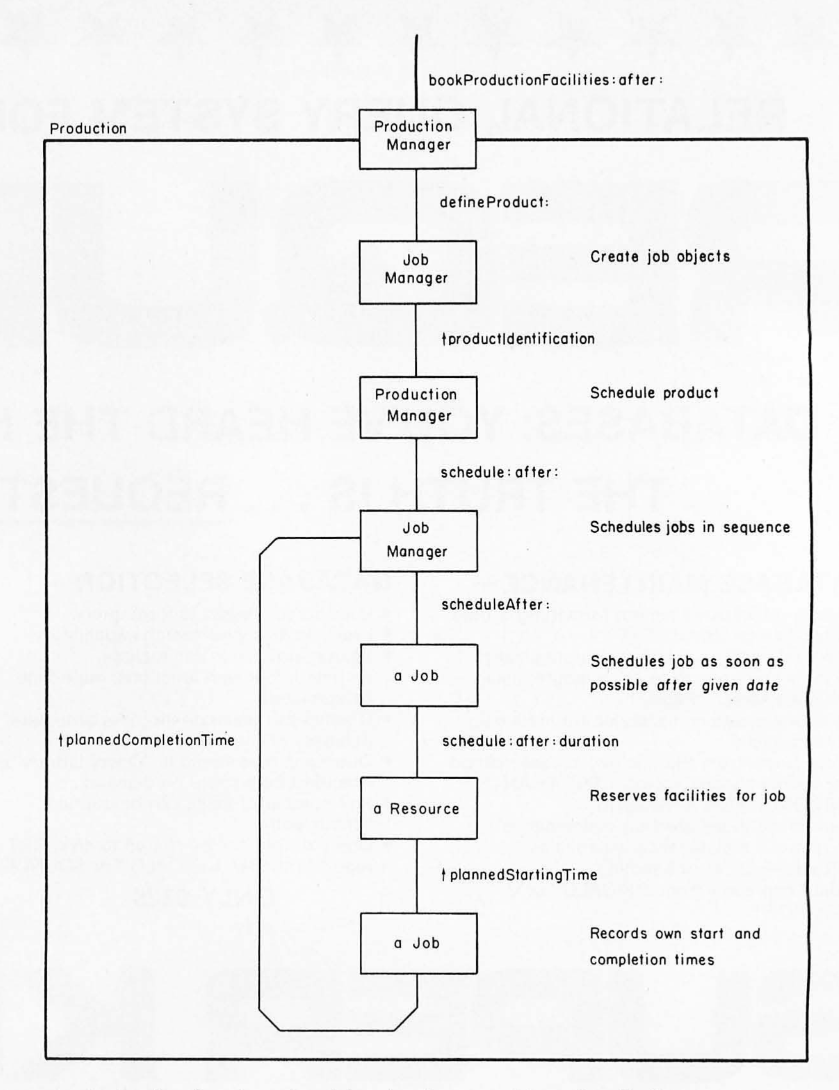


Figure 4: *A simple planning algorithm implemented in a Smalltalk system.*

Listing 3: *Smalltalk method for the message* defineProduct:.

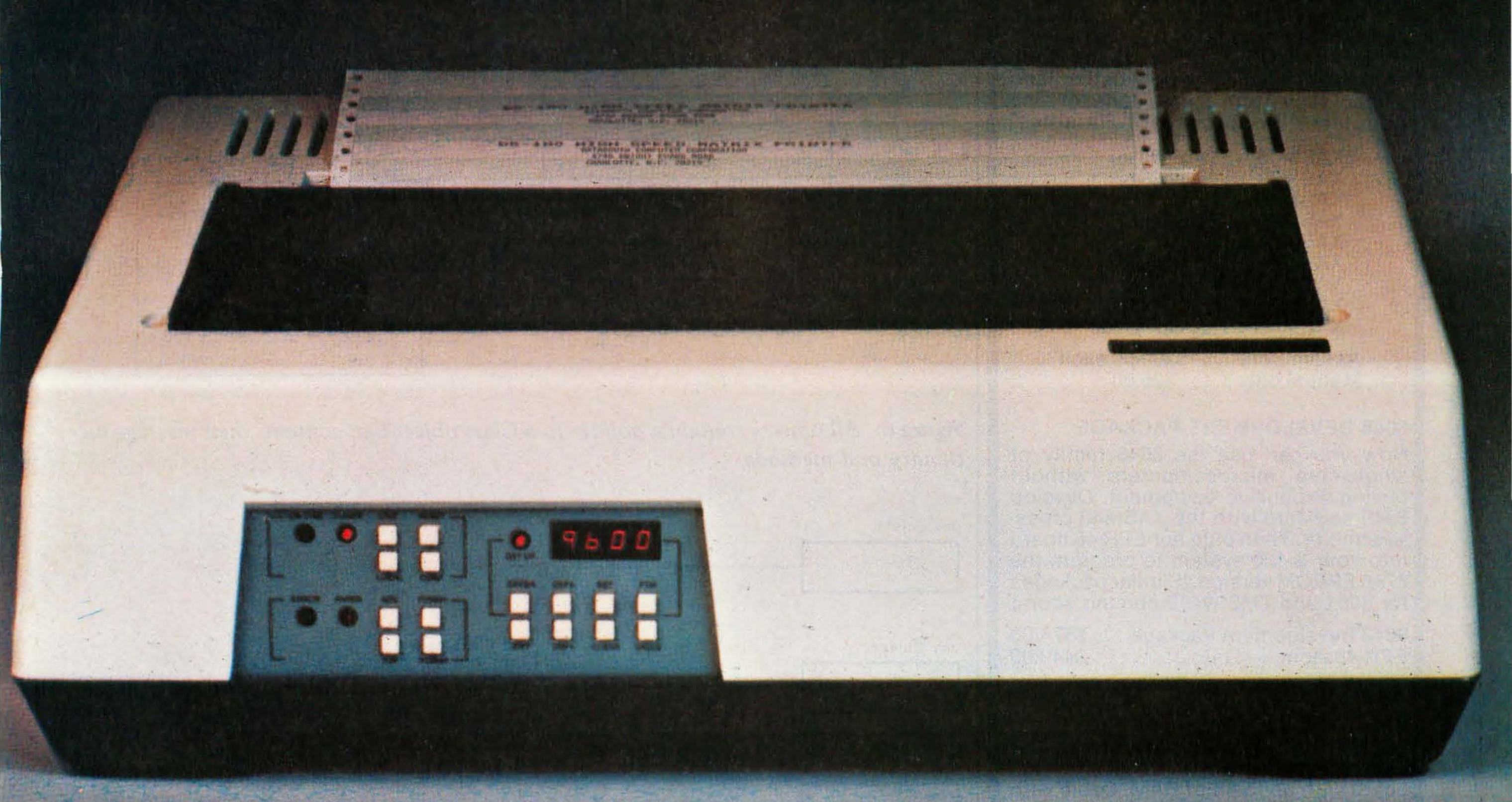
```
defineProduct: productType
   "To create a new product of given type. The corresponding Job objects are created and linked to
   their resource objects."
   | productIdentification jobDescriptions job jobList resourceObject |
   productIdentification ← self nextProductIdentification.
   jobDescriptions ← productDescriptions at: productType.
   jobList ← jobDescriptions collect:
       [ :description |
       job ← (description class) new.
       job duration: (description duration).
       resourceObject ← productionManager getResource: (description
       resourceType).
       job resource: resourceObject].
   productDictionary at: productIdentification put: jobList.
   ↑ productIdentification.
```

tionary. In this dictionary, each key is a product identification; the corresponding entry is the sequence of job objects for that product.

The first line of code gets a new, unique identification for the new product. Next, the list of job descriptions is retrieved from the productSpecification collection. We then build the sequence of Job objects by going systematically through the job descriptions. For each description, we create a new Job object of the given class, feed it its duration, and let it

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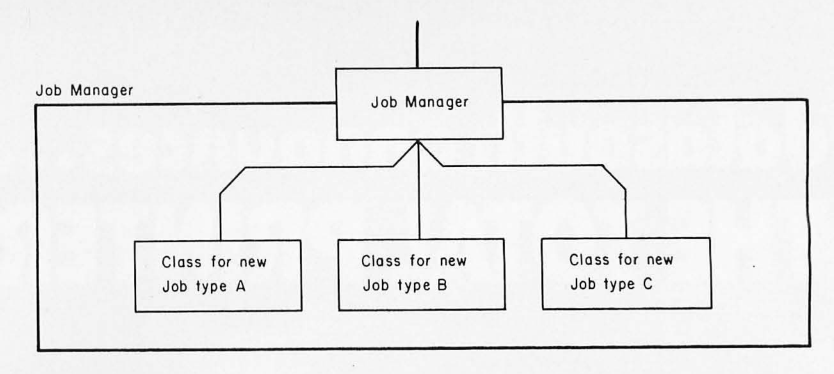


Figure 5: *Sub-objects in the Job Manager actually create the new Job objects.*

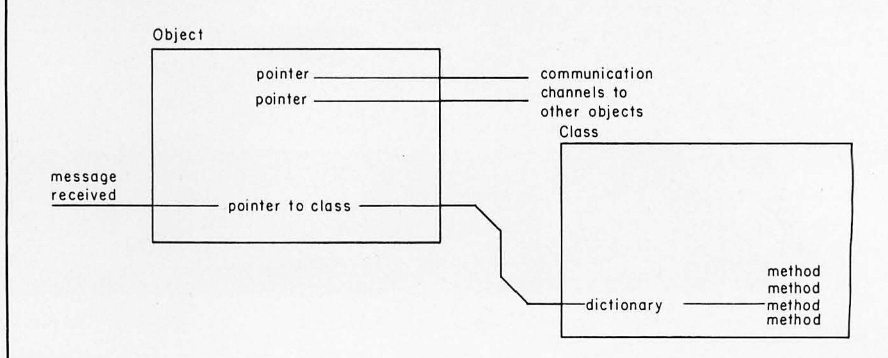


Figure 6: *All objects contain a pointer to a Class object that contains their message dictionary and methods.*

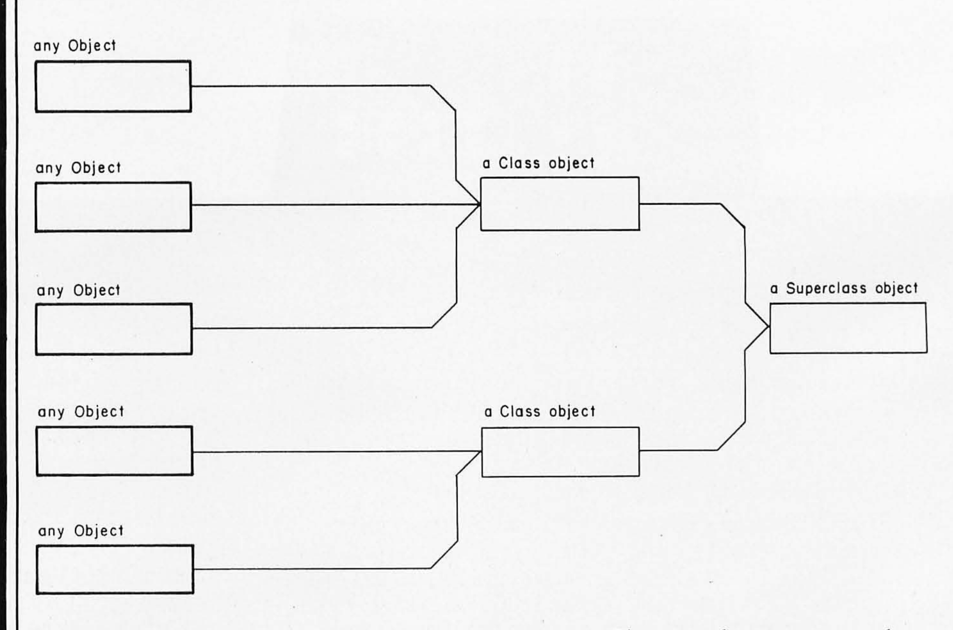


Figure 7: *The superclass-subclass chains of pointers. The user does not meet them unless he wants to become a real Smalltalk expert.*

connect itself to its Resource object. From figure 3, we see that there is no direct connection between the Job Manager object and the resources. We therefore have to go via the Production Manager object to get the pointer to the Resource object that we give to the new Job object.

We finally insert the new list of jobs into the productDictionary in the Production Manager object and return the product identification.

The Job Manager is built so that Job objects may belong to several different classes. The different Job objects created would all understand the

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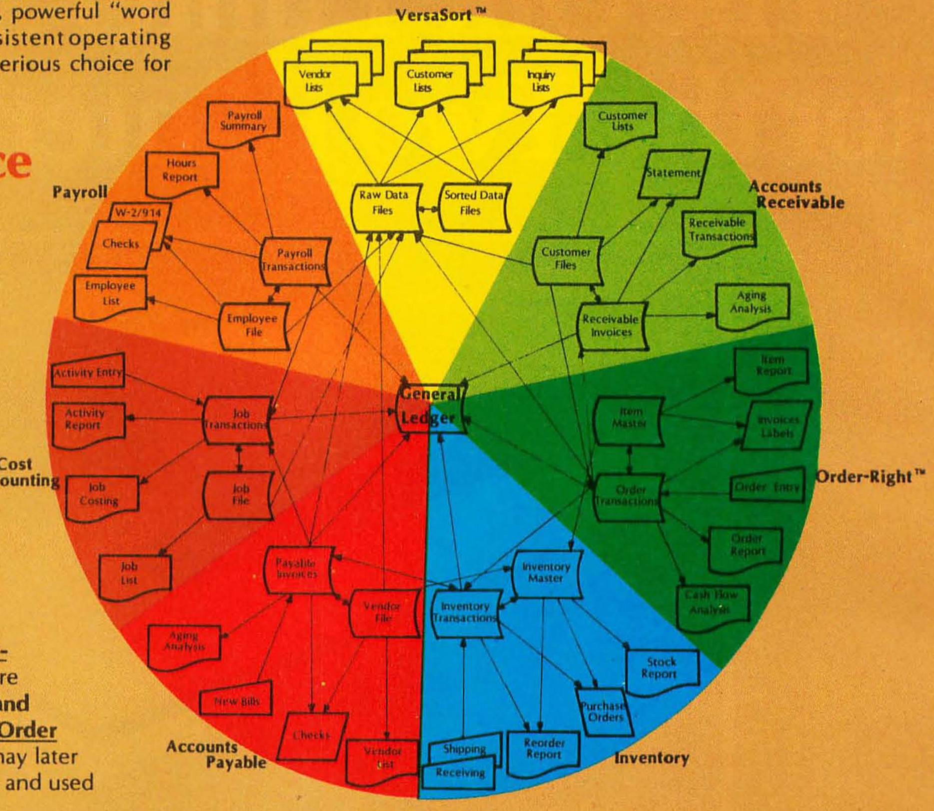
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same message protocols, but they would differ in their implementation. For example, a job might be: *wait for 24 hours while a resin glue is curing*. This does not need any resources, and the planning of such a job would be very simple—wait 24 hours. Another kind of job, such as pouring concrete, should not span a weekend, since joining old and new concrete could give weak spots in the product.

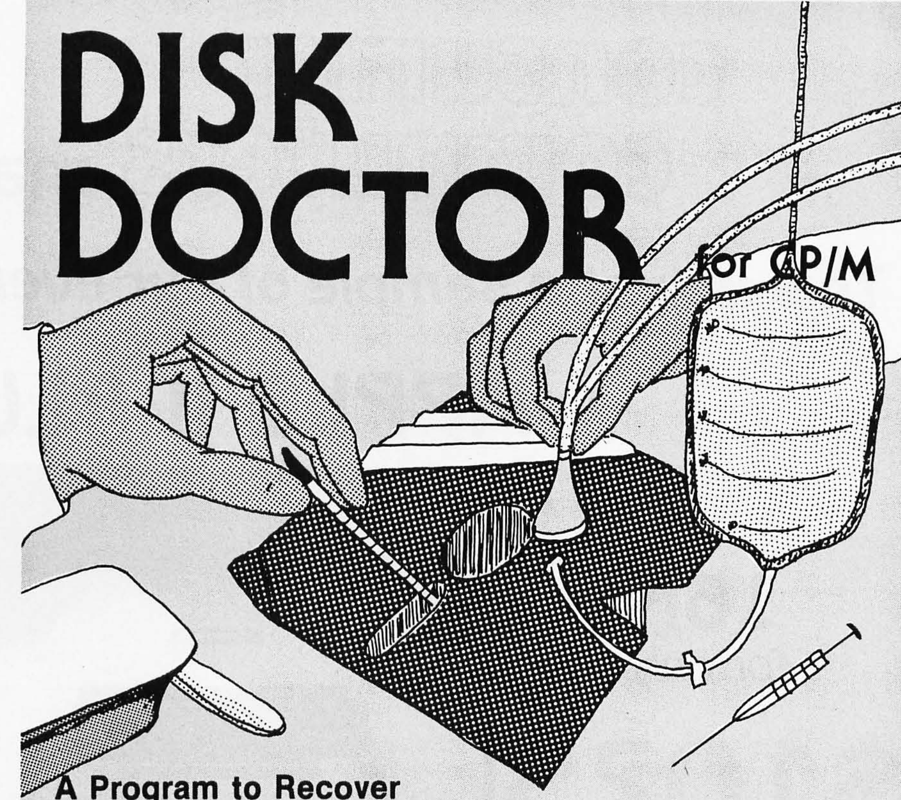
As is the case with Job objects, we often find that several objects share the same message protocols and process the messages with the same methods. Their only difference is that they appear in different places in the total system and that their instance

The Smalltalk user should be able to "open up" the application object on the screen to see its component parts and to find out how they work together.

variables point to different objects (their states are different). Such objects are created by the same class object and are said to belong to the same class.

It would be very inefficient if each object of a class stored a replica of the message dictionary and all methods, and it would be extremely tiresome if we actually had to program each object by itself. We, therefore, use the concept of layering to let each and every object enlist the services of its class object in order to decode an incoming message and to select the proper method to process it. This mechanism is illustrated in figure 6. As in so many other parts of Smalltalk, we find a recursive argument.

Many classes are very similar; they differ only in the handling of a few messages. The different kinds of Job objects are a case in point. It seems reasonable to let a class object enlist the services of a superclass object whenever it is called upon to execute methods it shares with other classes.



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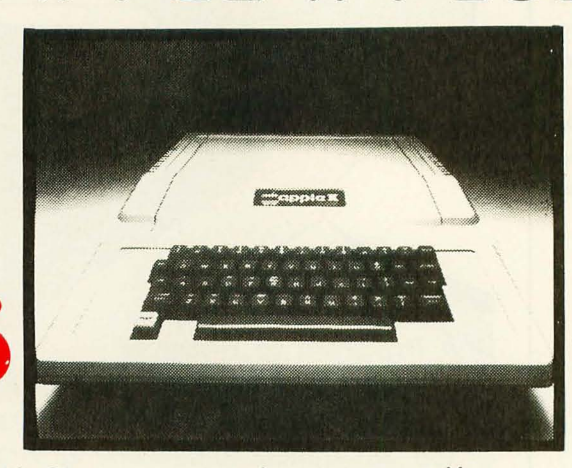
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Many classes will then share the same superclass; we get a tree-shaped class structure as shown in figure 7. Note that the purpose of this structure is convenience in programming and efficiency in implementation; it belongs on the lowest levels of the system hierarchy and is not part of the structure of the application system.

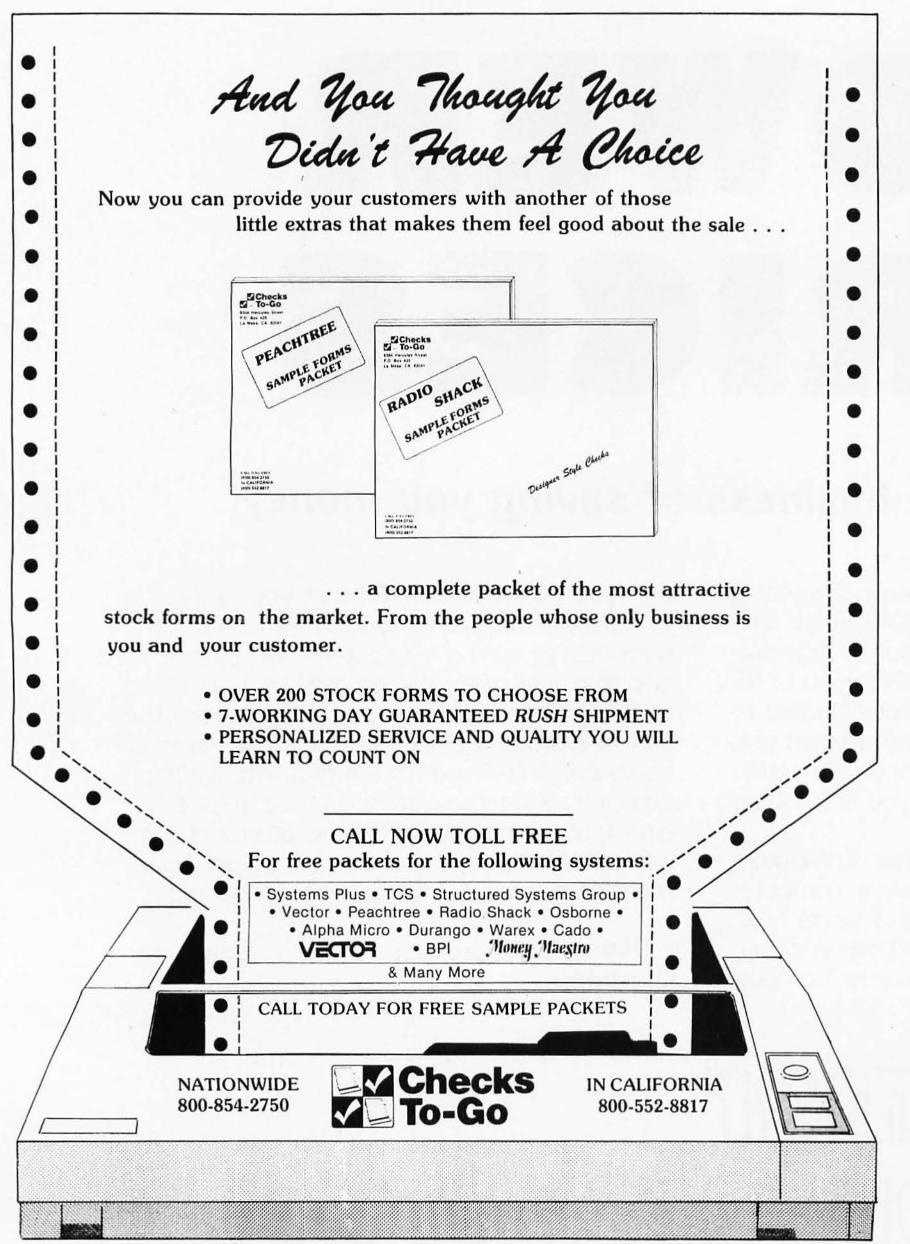
Future Experiments

When personal computing becomes sufficiently entertaining and interesting to become a widespread tool, the new user of a Smalltalk system is likely to begin by using its ready-made application systems for writing and illustrating documents, for designing aircraft wings, for doing homework, for searching through old court decisions, for composing music, or whatever. After a while, he may become curious as to how his system works. He should then be able to "open up" the application object on the screen to see its component parts and to find out how they work together. He could, for example, see something like figure 1 together with his usual user interface. By exercising the application commands, the computing process could be illustrated on the system diagram. Using Smalltalk to document itself in this manner should make it possible to make some novel and extremely powerful system description tools.

The next thing the user might want to do is to build new systems similar to the one he has been using. A *kit* of graphical building blocks would let the user compose a new system by editing the system diagram on the screen. While the Trip system (as described in reference 2) is not a proper kit, it could be a good source of ideas to the experimenter on building such systems.

Finally, the expert user would want to make his own kits. Even here, it is important that he sees only what he needs and that all unimportant details are suppressed. Since what is important in one context might be unimportant in another, and vice versa, the concepts of *filters* (see reference 1) will be an essential ingredient for the experimenter when he develops tools for these expert users.

Much experimenting needs to be done before we learn how to make systems that are self-documenting on any level and that provide a smooth and stumble-free transition from one level to the next. It is hoped that the availability of Smalltalk will lead to great activity in this field, to the benefit of all future computer users. ■



References

1. Goldberg, Adele and David Robson. "A Metaphor for User Interface Design." *Proceedings of the University of Hawaii Systems Science Symposium*, January 1979, Honolulu.
2. Gould, Laura and William Finzer. "A Study of TRIP: A Computer System for Animating Time-Rate-Distance Problems." *Proceedings of the IFIP World Conference on Computers in Education (WCCE-81)*, Lausanne, Switzerland, July 1981.
3. Ingalls, Daniel H H. "The Smalltalk-76 Programming System. Design and Implementation." *Conference Record of the Fifth Annual ACM Symposium on Principles of Programming Languages*, Tucson, Arizona, January 1978.

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The Smalltalk Graphics Kernel

Daniel H H Ingalls
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Graphics are essential to the quality of an interactive programming system and to the interactive applications that go along with such a system. Qualitatively, people think with images, and any system that is incapable of manipulating images is incapable of augmenting such thought. Quantitatively, a person can visually absorb information equivalent to millions of characters a second, while the normal rate for reading text is less than 100 characters a second.

For the graphical interaction cycle to be complete, a computer system must provide a channel for input in the visual domain as well. While the projection of images from the realm of thought into the space of electronic information seems an impossible task, a well-designed pointing device can effectively harness the computer's graphical output capability to express graphical input from the user. Given such a pointing device, the process of selecting from graphical objects, such as text displayed on the screen, is natural and rapid. By tracking the pointer with a program that simulates a pen or paintbrush, the visual input channel can be extended to include line drawing and freehand sketches.

The purpose of graphics in the Smalltalk system is to support the *reactive principle*:

Any object accessible to the user should be able to present itself in a meaningful way for observation and manipulation.

Meaningful presentation of any object in the system demands maximum control over the display medium, and many technologies fall short in this respect. One approach that provides the necessary flexibility is to allow the brightness of every discernible point in the displayed image to be independently controlled. The simplest implementation of this approach is a contiguous block of storage in which the setting of each *bit* (1 or 0) is *mapped* into dark or light illumination of the corresponding picture element, or *pixel*, when displaying or combining with other images. The block of storage is thus referred to as a *bitmap*, and this type of display is called a *bitmap display*. The simplest form of bitmap allows only two brightness levels, white and black. The Smalltalk-80 graphics system is built around this model.

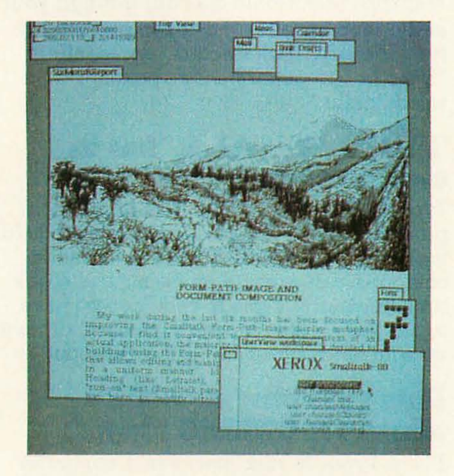


Photo 1: *An example of a Smalltalk-80 video display. Note the multiple windows, the combinations of text and graphics, and the pointer in the window marked "UserView workspace."*

Photo 1 shows a typical view of the Smalltalk-80 system, and it illustrates the wide range of graphical idiom implied by the reactive principle. Rectangular areas of arbitrary size are filled with white, black, and various halftone patterns. Text, in various typefaces, is placed on the screen from stored images of the individual characters. Halftone shades are "brushed" by the user to create freehand paintings. Moreover, although not shown on the printed page, images on the display may be moved or sequenced in time to provide animation.

Graphical Storage—Forms

Simple images are represented by instances of class Form. A Form has height and width and a bitmap that indicates the white and black regions of the particular image being represented. Consider, for example, the arrow-shaped Form that appears in the lower-right window of the screen image in photo 1. The internal representation of this Form is depicted in figure 1. Its height is 16, its width is 8, and its appearance is described by the pattern of ones and zeros (shown as light and dark squares) in its bitmap. The height and width of the Form serve to impose the

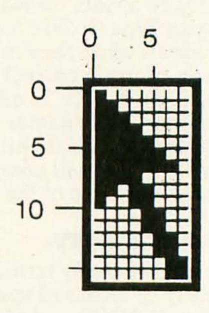


Figure 1: *A simple* Form *representing the cursor in photo 1.*

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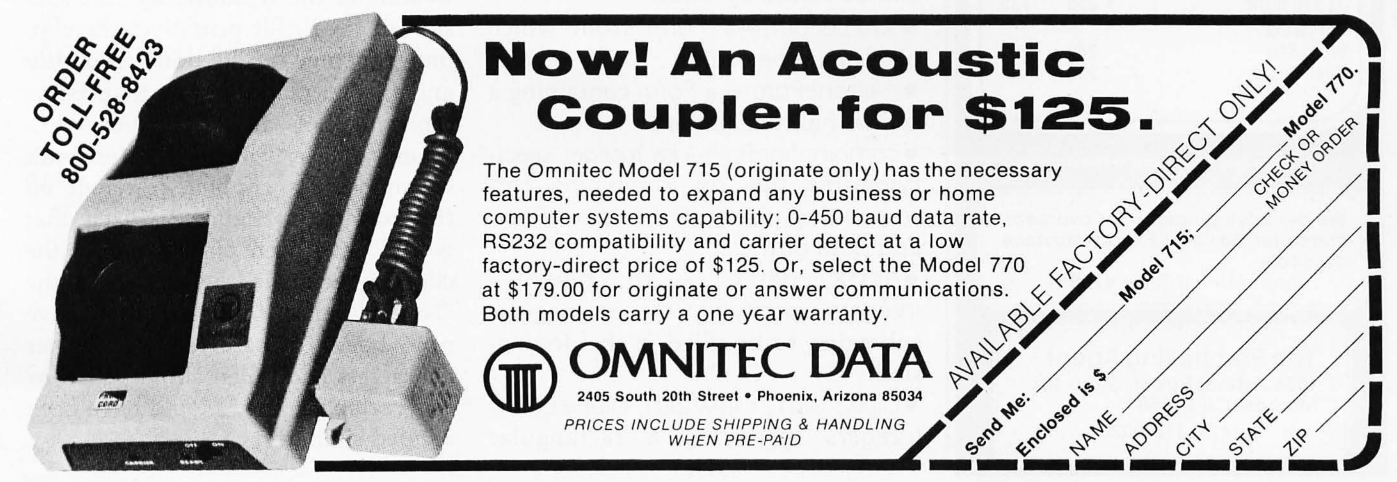
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Figure 2: *Copying a character of text from a source* Form *(bottom) to a destination* Form *(top).*

appropriate two-dimensional ordering on the otherwise unstructured data in the bitmap. We will return to the representation of Forms in more detail later in this article.

A complex image can be represented in either of two ways: by a very large Form, or by a structure that includes many Forms and rules for combining and repeating them in order to produce the desired image. The freehand drawing in the center of photo 1 is an example of the former, and the text below it is an example of the latter.

The large unstructured Form has an additional use of great importance: it can be presented to the display hardware as a buffer in memory of the actual data to be shown on the display terminal. We refer to the Form which is so used as the displayForm. Since the interface to the hardware is through a Form, there is no difference between combining images internally and displaying them on the screen. Animation can be done simply in this manner: one Form serves as the displayForm while the next image to be displayed is



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prepared in a second Form. As each image is completed, the two Forms exchange roles, causing the new image to be displayed and making the Form with the old image available for building the next image in sequence.

Graphical Manipulation—BitBlt

To support a wide range of graphical presentation, we have specified a kernel operation on Forms that we call *BitBlt*. All text and graphic objects in Smalltalk are displayed and modified using this single graphical primitive. The author wrote the original design in October 1975 with the advice and support of Diana Merry. After five years' experience, we have felt the need for only minor changes, and these improvements are largely due to Bob Flegal and Bill Bowman. The remainder of this article describes the current BitBlt primitive in detail—its specification, examples of its use, and, finally, the details of its implementation.

One of the first computers on which a Smalltalk system was implemented had an instruction called BLT for *block transfer* of 16-bit words. The name BitBlt derives from the generalization of data transfer to arbitrary bit locations, or pixels. BitBlt is intentionally a very general operation, although most applications of it are graphically simple, such as "move this rectangle of pixels from here to there."

A specific application of BitBlt is governed by a list of parameters that includes:

- destForm—a Form into which pixels will be stored by BitBlt
- sourceForm—a Form from which pixels may be copied
- halftoneForm—a Form containing a spatial halftone pattern
- combinationRule—an Integer specifying the rule for combining corresponding pixels of the sourceForm and destForm
- destX, destY, width, height—Integers specifying the rectangular subregion to be filled in the destination
- clipX, clipY, clipWidth, clipHeight—Integers specifying a rectangular boundary that *further restricts the affected region of the destination*
- sourceX, sourceY—Integers specifying the location (top left) of the subregion to be copied from the source

In the remainder of this section, we examine the effect of each of these parameters in greater detail.

Source and Destination Forms

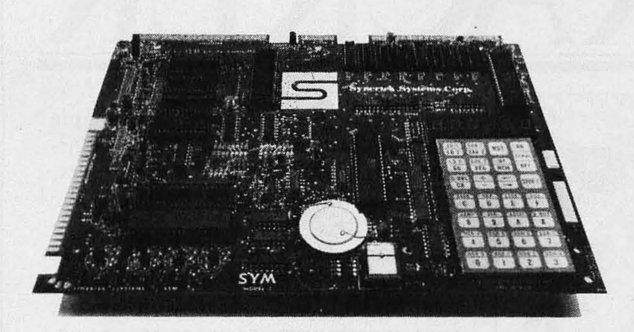
Figure 2 illustrates the process of copying a character of text into a region on the display. This operation will serve to illustrate most of the characteristics of BitBlt. The copy operation involves two Forms, a source and a destination. The source in this example is a *font* containing a set of character glyphs depicted in some uniform style and scale and packed together horizontally. Pixels are copied out of the source (the font) and stored into the destination (the display). The width and height of the transfer correspond to the character size. The source *x* and *y* coordinates give the character's location in the font, and the destination coordinates specify the position on the display where its copy will appear.

Clipping Rectangle

In its specification, BitBlt includes a rectangle that limits the region of the destination that can be affected by its operation, independent of the other destination parameters. We call this rectangle the *clipping rectangle.* Often it is desirable to display a partial *window* onto larger scenes, and the clipping rectangle ensures that all picture elements fall inside the bounds of the window. By its inclusion in the BitBlt primitive, the clipping function can be done efficiently and in one place, rather than being replicated in all application programs. Figure 3 illustrates the result of imposing a clipping rectangle on the example of figure 2. Pixels that would have been placed outside the clipping rectangle (the left edge of the "N" and half of the word "the") have not been transferred. If other characters had fallen above or below this rectangle, they would have been clipped similarly.

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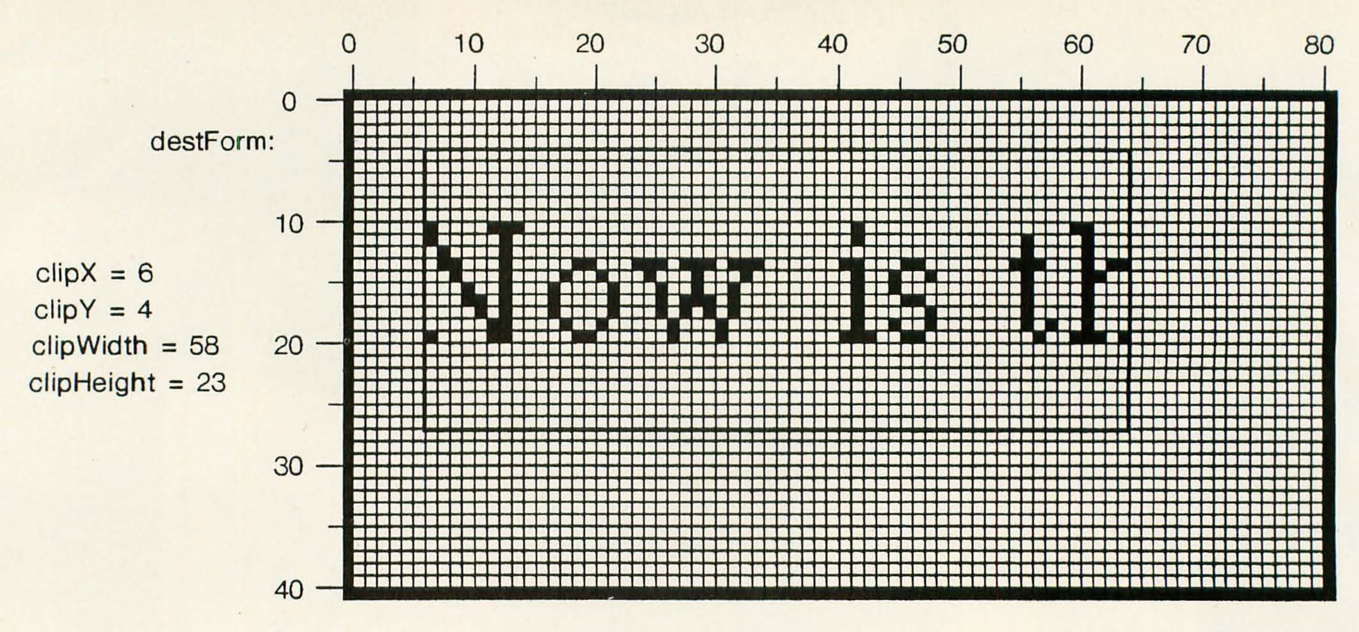


Figure 3: *An example of using a clipping window on the illustration in figure 2.*

Halftone Form

It is often desirable to fill areas with a regular pattern that gives the effect of gray shading or texture. To this end, BitBlt provides for reference to a third Form (halftoneForm) containing the desired pattern. This Form is restricted to a height and width of 16. When halftoning is specified, this pattern is effectively repeated every 16 units horizontally and vertically over the entire destination. There are four "modes" of supplying pixels from the source and halftone controlled by eliding (supplying nil for) sourceForm or halftoneForm:

- *Mode 0*—No source, no halftone (supplies solid black)
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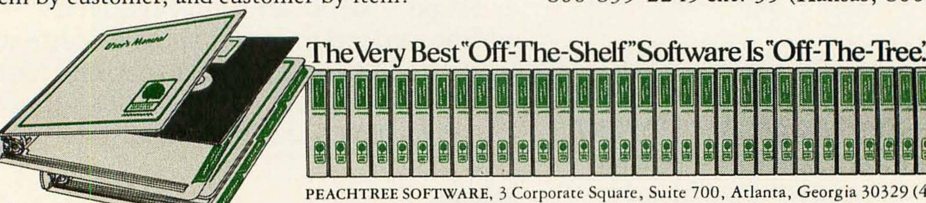
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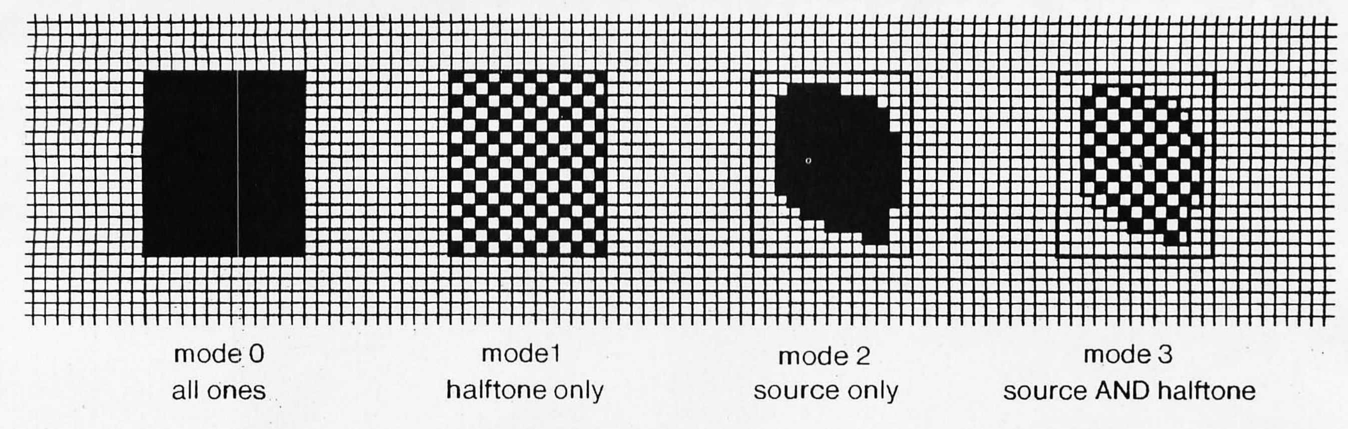


Figure 4: *BitBlt's four possible source modes.*

•*Mode 2*—Source only (supplies source pixels)
•*Mode 3*—Source AND halftone (supplies source bits masked by halftone pattern)

Figure 4 illustrates the effect of these four modes with the same source and destination and a regular gray halftone.

Combination Rule

The examples above have all stored their results directly into the destination. There are actually many possible rules for combining each source element S with the corresponding destination element D to produce the new destination element D'. Such a rule must specify a white or black result for each of the four cases of source being white or black and destination being white or black.

Figure 5 shows a box with four cells corresponding to the four cases encountered when combining source (S) and destination (D). For instance, the cell numbered 2 corresponds to the case where the source was black and the destination was white. By appropriately filling the four cells with white or black, the box can be made to depict any combination rule (there are sixteen possible rules altogether). The numbers in the four cells relate the rule as depicted to the integer value that selects that rule. For instance, to specify that the result

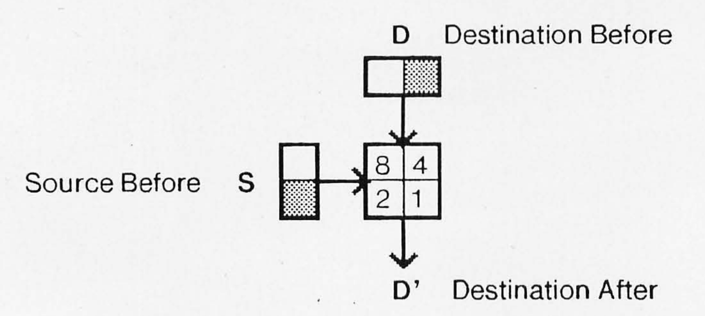
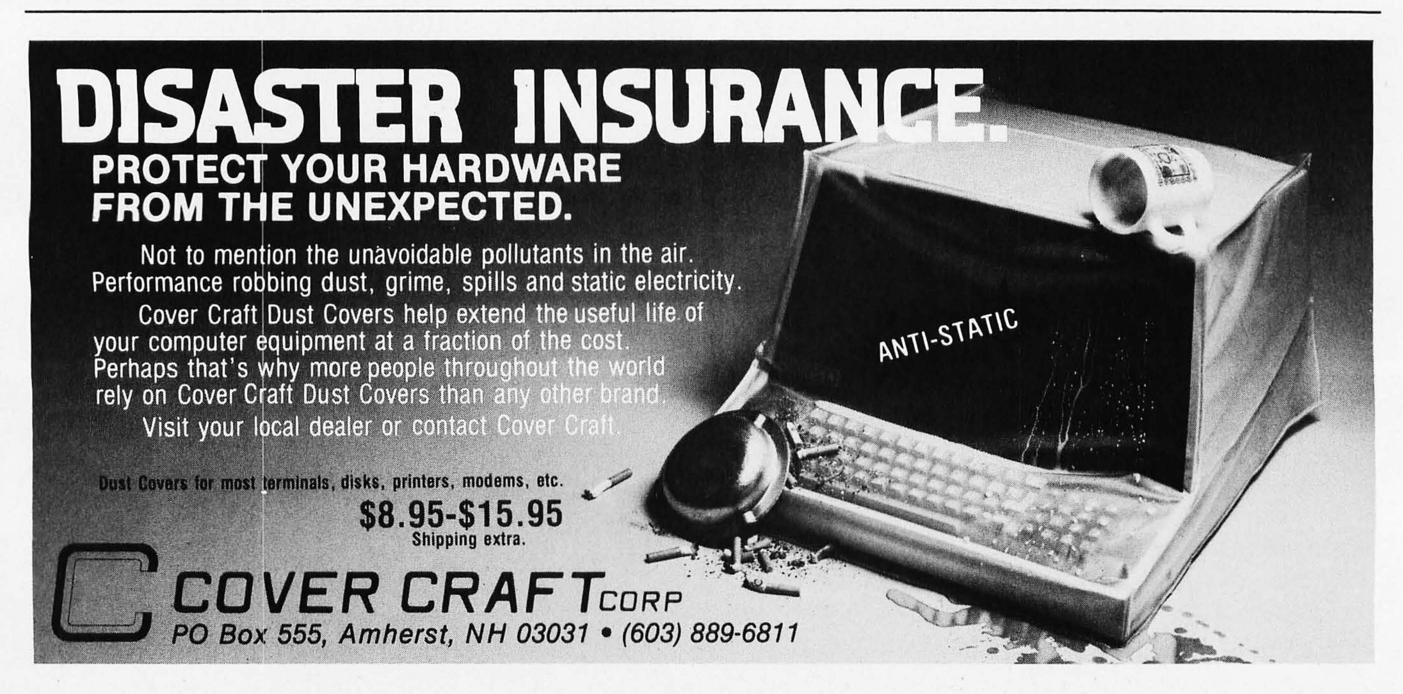
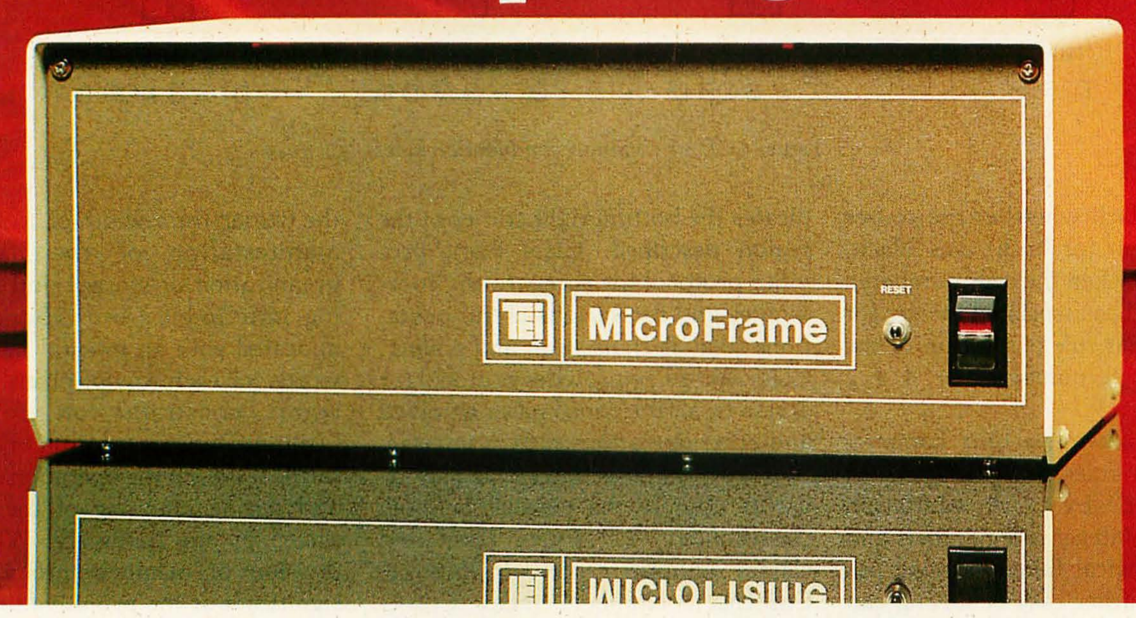


Figure 5: *A BitBlt combination diagram. This diagram, when filled in, specifies the effects of a given combination (or "rule") on all combinations of dark and light source and destination cells. Each combination is given a number equal to the sum of the cells that are darkened. See figure 6 for examples.*



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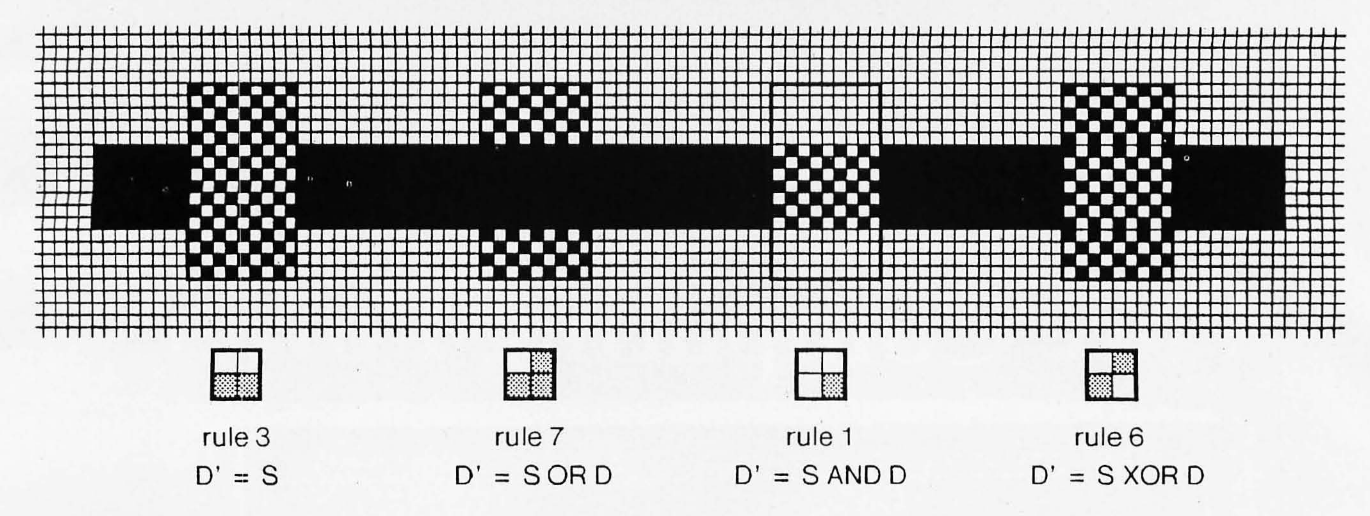


Figure 6: *Four common combination rules.*

should be black wherever the source or destination (or both) was black, we would blacken the cells numbered 4, 2, and 1. The associated integer for specifying that rule is the sum of the blackened cell numbers, or 4 + 2 + 1 = 7.

Figure 6 illustrates four common combination rules graphically. Each is described by a combination diagram, its integer rule number, and the actual logical function being applied. The earlier case of ORing can be seen in left center of the figure. This case is often described as painting "under" the destination because existing black areas remain black.

Smalltalk Access to BitBlt

In this section, we present the Smalltalk interface to BitBlt and take a detailed look at the application of BitBlt to text display and line drawing. In preparation, you will need some additional context, which we present here before describing class BitBlt.

Besides class Form, two additional classes are used extensively in working with stored images, Point and Rectangle. Points contain x and y coordinate values and are used for referring to pixel locations relative to the top left corner of a Form (or other point of reference). By convention, x increases to the right and y down, consistent with the layout of text on a page and the direction of TV scanning. A Rectangle contains two Points: origin, which specifies the top left corner, and corner, which indicates the bottom right corner of the region described. Class Point provides protocol for access to the coordinates and for various useful operations such as translation and scaling. Class Rectangle provides protocol for access to all the coordinates involved and other operations such as intersection with other rectangles. It may be useful to note the parallel between classes Point, Rectangle, Form and classes Number, Interval, IndexedCollection. Numbers index Collections and Points index Forms. Intervals select subCollections, and Rectangles select subForms.

Figure 7 shows the complete representation of the Form shown in figure 1. The width and height are stored as Integers. The actual pixels are stored in a separate instance of class Bitmap. Bitmaps have almost no protocol, since their sole purpose is to provide storage for Forms. They also have no intrinsic dimensionality, apart from that projected by their own Form, although the figure retains this structure for clarity. It can be seen that space has been provided in the Bitmap for a width of 16; this is a manifestation of the hardware organization of storage and processing into 16-bit *words*. Bitmaps are allocated with an integral number of words for each row of pixels. The integral constraint on row size facilitates movement from one row to the next during the operation of BitBlt and during scanning of the display screen by the hardware. While this division of memory into words is significant at the primitive level, it is encapsulated in such a way that none of the higher-level graphical components in the system need consider word size.

Class BitBlt

The most basic interface to BitBlt is through a class of the same name. Each instance of BitBlt contains the parameters necessary to specify a BitBlt operation. The BitBlt protocol includes messages for initializing the parameters and one message, copyBits, that causes the primitive operation to take place. The class template for BitBlt is given in table 1.

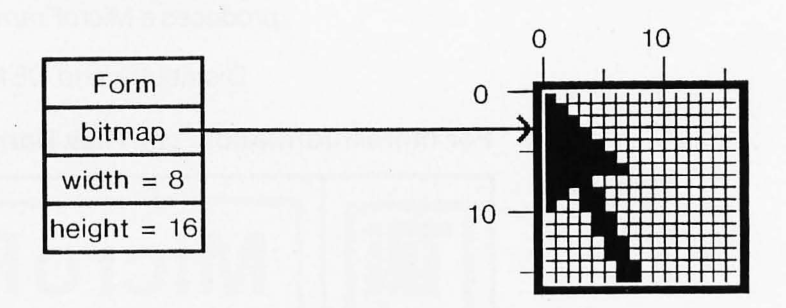
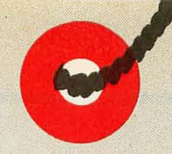


Figure 7: *The complete representation of figure 1.*

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class name	BitBlt
superclass	Object
instance variable names	destForm sourceForm halftoneForm combinationRule destX destY width height clipX clipY clipWidth clipHeight sourceX sourceY
instance messages and methods	

setup

```
destForm: form1 sourceForm: form2 halftoneForm: form3 rule:
   rule destRectangle: destRectangle clipRectangle: clipRectangle
   sourceOrigin: sourceOrigin | |

    destForm ← form1.
    sourceForm ← form2.
    halftoneForm ← form3.
    combinationRule ← rule.

    destX ← destRectangle minX.
    destY ← destRectangle minY.
    width ← destRectangle width.
    height ← destRectangle height.

    clipX ← clipRectangle minX.
    clipY ← clipRectangle minY.
    clipWidth ← clipRectangle width.
    clipHeight ← clipRectangle height.

    sourceForm == nil ifFalse:
       [sourceX ← sourceOrigin x.
       sourceY ← sourceOrigin y].

    self copyBits
```

operations

```
copyBits | | < primitive >
```

Table 1: *Class template for class* BitBlt.

The state held in an instance of BitBlt allows multiple operations in a related context to be performed without the need to repeat all the setup. For example, when displaying a scene in a display window, the destination Form and clipping rectangle will not change from one operation to the next. This situation occurs frequently in the graphics kernel, as demonstrated in the following section.

Image Synthesis of Text

Much of the graphics in the Smalltalk system consists of text and lines. These high-level entities are synthesized by repeated invocation of BitBlt. In this section and the next, we examine these two important applications more closely.

One of the advantages derived from BitBlt is the ability to store fonts compactly and to display them using various combination rules. The compact storage arises from the possibility of packing characters horizontally one next to another (as shown in figure 2), since BitBlt can extract the relevant bits if supplied with a table of left x coordinates of all the characters. This is called a *strike* format, from the typographical term meaning a contiguous display of all the characters in a font.

The scanning and display of text is performed in the Smalltalk-80 system by a subclass of BitBlt. This subclass inherits all the normal state, with destForm indicating the Form in which text is to be displayed and sourceForm indicating a Form containing all the character glyphs side by side (as in figure 2). In addition, this subclass defines further state information, including:

- text—a String of Characters to be displayed
- textPos—an Integer giving the current position in text

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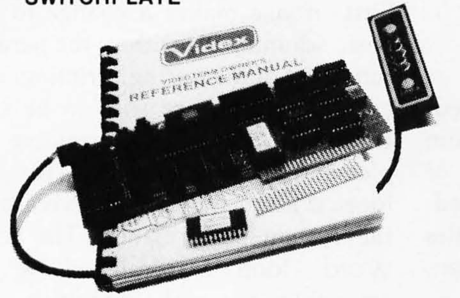
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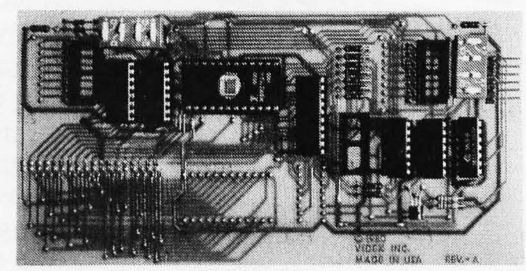
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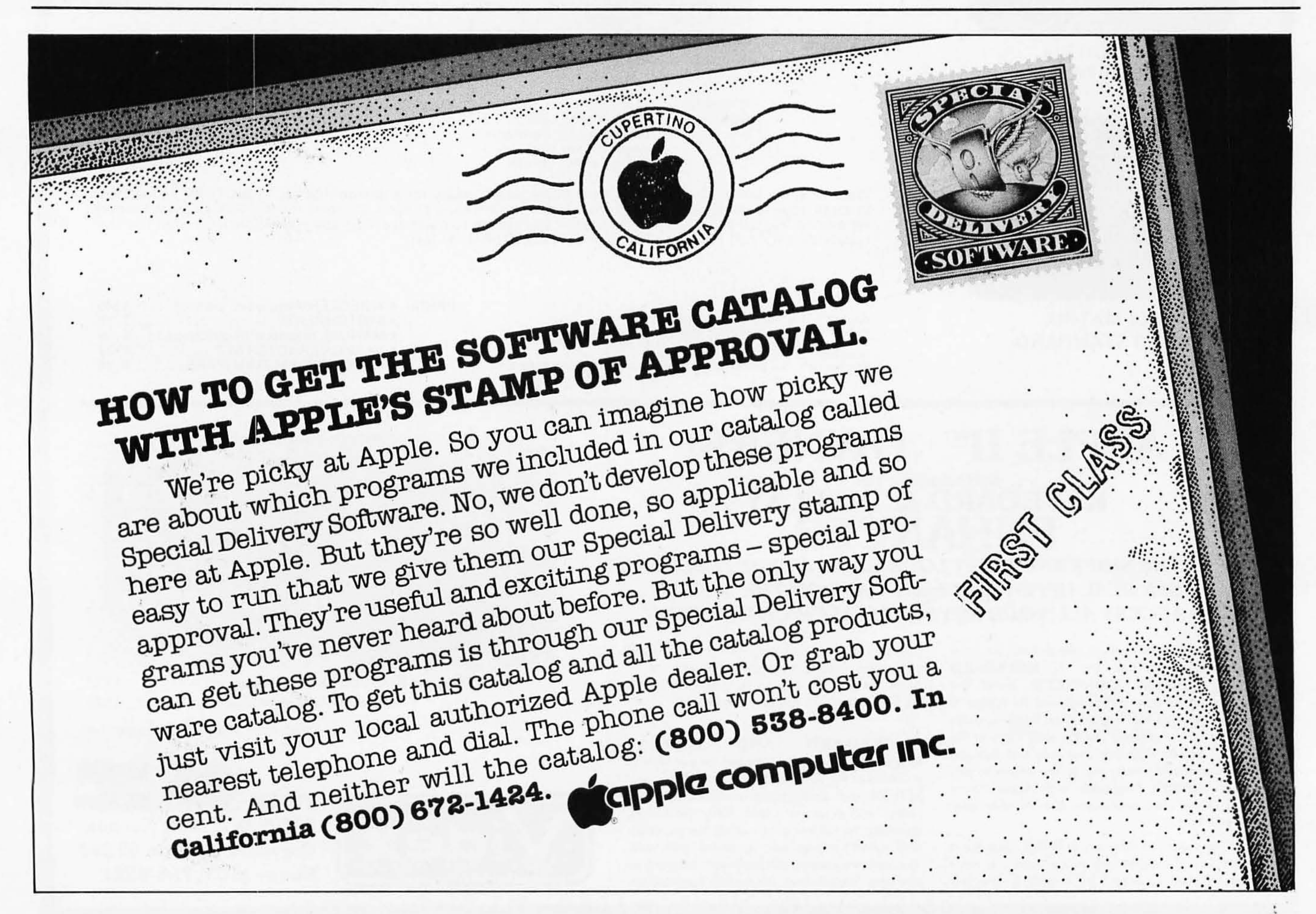
Listing 1: *The* scanWord: *method scans or prints text.*

```
scanWord: endRun
   | charIndex |
   < primitive >   "May be implemented internally for speed"
   [charIndex > endRun] whileTrue:
      [charIndex ← text at: textPos.                          "pick character"
      (exceptions at: charIndex) > 0                          "check exceptions"
         ifTrue: [↑ exceptions at: charIndex].
      sourceX ← xTable at: charIndex.                         "left x of character in font"
      width ← (xTable at: charIndex + 1) − sourceX.           "up to left of next char"
      printing ifTrue: [self copyBits].                       "print the character"
      destX ← destX + width.                                  "advance by width of character"
      destX > stopX ifTrue: [↑ stopXCode].                    "passed right boundary"
      textPos ← textPos + 1].                                 "advance to next character"
   textPos ← textPos − 1.
   ↑ endRunCode
```

- xTable—an Array of Integers giving the left x location of each character in sourceForm
- stopX—an Integer that sets a right boundary past which the inner loop should stop scanning
- exceptions—an Array of Integers that, if non-zero, indicate that the corresponding characters must be specially handled

Once an instance has been initialized with a given font and text location, the scanWord: loop given in listing 1 will scan or print text until some horizontal position (stopX) is passed, a special character (determined from exceptions) is found, or the end of this range of text (endRun) is reached.

The check on exceptions handles many possibilities in one operation. The space character may have to be handled exceptionally in the case of text that is padded to achieve a flush right margin. Tabs usually require a computation or table check to determine their width. Carriage return is also identified in the check for exceptions. Character codes beyond the range given in the font are detected similarly and are usually handled by showing an exceptional character, such as a little lightning bolt, so that they can be seen and corrected. The printing flag can be set false to allow the same code to *measure* a line (break at a word boundary) or to find where the cursor points. While this provision may seem over-general, two benefits (besides compactness) are derived from that generality. First, if one makes a change to the basic scanning algorithm, the parallel functions of measuring, printing, and cursor tracking are sure to be synchronized. Second, if a primitive implementation is provided for the loop, it exerts a threefold leverage on the system performance. The scanWord: loop is designed to be amenable to such primitive implementation; that is, the interpreter may intercept it and execute primitive code instead of the Smalltalk code shown. In this way, much of the setup overhead for copyBits can be avoided at each character, and an entire word or more can be displayed



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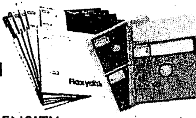
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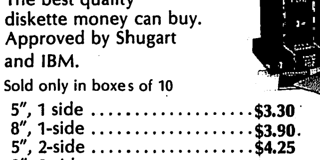
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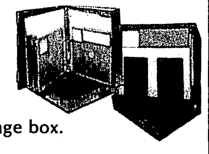
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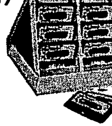
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Listing 2: *The* drawLoopX:Y: *method draws lines.*

```
drawLoopX: xDelta Y: yDelta
  | dx dy px py p i |
  < primitive >
  dx ← xDelta sign.
  dy ← yDelta sign.
  px ← yDelta abs.
  py ← xDelta abs.
  self copyBits.              "first point"

  py > px
    ifTrue:                   "more horizontal"
      [p ← py/ /2.
      1 to: py do:
        [:i | destx ← destx + dx.
        (p ← p − px) < 0 ifTrue: [desty ← desty + dy. p ← p + py].
        self copyBits]]
    ifFalse:                  "more vertical"
      [p ← px/ /2.
      1 to: px do:
        [:i | desty ← desty + dy.
        (p ← p − py)<0 ifTrue: [destx ← destx + dx. p ← p + px].
        self copyBits]]
```

Listing 3: *Methods for image magnification. @ is a shorthand message that returns a new* Point *whose x-value is the receiver (on the left) and whose y-value is the argument (on the right).* Points *respond to the + and * messages by distributing them over each of the coordinates.*

```
magnify: rect by: scale spacing: spacing
  | wideForm bigForm |                          "First expand horizontally"
  wideForm ← Form extent: (rect width * scale x) @ rect height.
  wideForm spread: rect from: self by: scale x
    spacing: spacing x direction: 1 @ 0.
  bigForm ← Form extent: rect extent * scale.   "Then expand vertically"
  bigForm spread: wideForm asRectangle from: wideForm by: scale y
    spacing: spacing y direction: 0 @ 1.
  ↑ bigForm

spread: rect from: sourceForm by: scale spacing: spacing
 direction: dir
  | slice sourcePt |
  slice ← Rectangle origin: 0 @ 0 extent: dir transpose * self extent + dir.
  sourcePt ← rect origin.    "transpose returns a Point with swapped coordinates"
  1 to: (rect extent dot: dir) do:    "dot product selects direction of stretch"
    [:i |     "slice up the original image"
    self copy: slice from: sourcePt in: sourceForm rule: STORing.
    sourcePt ← sourcePt + dir. slice moveby: dir * scale].
  1 to: scale − spacing − 1 do:
    [:i |     "smear out the slices, leave some space"
    self copyAllTo: 1 @ 0 in: self rule: ORing]
```

directly. Conversely, the Smalltalk text and graphics system requires implementation of only the one primitive operation to provide full functionality.

Line Drawings, Image Synthesis

The same design principle applies in the support for drawing lines. By using BitBlt, one algorithm can draw lines of varying widths, different halftone "color," and any combination rule. To draw a line, an instance of BitBlt is initialized with the appropriate destination Form and clipping window, and with a source that can be any Form to be applied as a pen shape along the line. Starting from the stored destX and destY, the line-drawing loop, drawLoopX:Y: (listing 2), accepts *x* and *y* delta values and *x* and *y* step values as necessary, calling copyBits at each point along the line. The method used

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is the Bresenham plotting algorithm (*IBM Systems Journal*, Volume 4, Number 1, 1965). It chooses a principal direction and maintains a variable, p. When p's sign changes, it is time to move in the minor direction as well. This procedure is another natural unit to be implemented as a primitive, since the computation is trivial and the setup in copyBits is almost all constant from one invocation to the next.

Image Processing

We have seen how BitBlt can copy shapes and, in the foregoing examples, how repeated invocation can synthesize more complex images such as text and lines. BitBlt is also useful in the manipulation of existing images. For example, text can be made to look bold by ORing over itself, shifted right by one pixel. Just as complex images can be built from simple ones, complex processing can be achieved by repeated application of simple operations. Here, we present three examples of such structural manipulation: magnification, rotation, and the game of Life. These examples were devised by the author in collaboration with Ted Kaehler.

As we shall see in the next two sections, many applications of BitBlt are very simple, such as filling a Form with white, or copying all of one Form to some location in another. Smalltalk provides for such casual use of BitBlt through a wide range of simple messages to class Form, such as:

```
someForm fillAll: white.
someForm copyAllTo:
    destLocation in: destForm.
```

We will not list all such messages here. In the examples that follow, the reader should be able to infer the meaning from the message names and the accompanying explanations.

Magnification

It is often useful to magnify an image for closer scrutiny and especially to allow convenient alteration of stored Forms. Photo 1 shows this function providing user control over the font used for display of text.

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Listing 4: *The* rotate *method. This method rotates an image of size* 2^n *by* 2^n *one quarter-turn clockwise.*

```
rotate | mask temp quad |
   temp ← Form extent: self extent.
   mask ← Form extent: self extent.          "set up the first mask"
   mask copy: mask asRectangle halftone: white rule: STORing.
   mask copy: mask asRectangle/2 halftone: black rule: STORing.
   quad ← self width/2. "the size of a quadrant"
   [quad > = 1] whileTrueDo:
      [ "First exchange left and right halves"
      mask copyAllTo: 0 @ 0 in: temp rule: STORing.
      mask copyAllTo: 0 @ quad in: temp rule: ORing.
      self copyAllTo: 0 @ 0 in: temp rule: ANDing.
      temp copyAllTo: 0 @ 0 in: self rule: XORing.
      temp copyAllFrom: quad @ 0 in: self rule: XORing.
      self copyAllTo: (0 − quad) @ 0 in: self rule: ORing.
      temp copyAllTo: quad @ 0 in: self rule: XORing.
       "Then flip the diagonals"
      self copyAllTo: 0 @ 0 in: temp rule: STORing.
      temp copyAllFrom: quad @ quad in: self rule XORing.
      mask copyAllTo: 0 @ 0 in: temp rule: ANDing.
      temp copyAllTo: 0 @ 0 in: self rule: XORing.
      temp copyAllTo: quad @ quad in: self rule: XORing.
       "Compute the next fine mask"
      mask copyAllFrom: (quad/2) @ (quad/2) in: mask rule: ANDing.
      mask copyAllTo: quad @ 0 in: mask rule: ORing.
      mask copyAllTo: 0 @ quad in: mask rule: ORing.
      quad ← quad/2]
```

The character for "7" has been presented magnified nine times. Using a pointing device, the user has blackened some cells to provide a European style "7," and the result can be seen in both the upper-left and lower-right windows on the screen.

A simple way to magnify a stored Form would be to copy it to a larger Form, making a big dot for every little dot in the original. For a height h and width w, this would take $h \times w$ operations. The algorithm presented in listing 3 (as two messages to class Form) uses only a few more than $h + w$ operations.

The magnification proceeds in two steps. First, it slices up the image into vertical strips in wideForm separated by a space equal to the magnification factor. These are then smeared, using the ORing function, over the intervening area to achieve the horizontal magnification. The process is then repeated from wideForm into bigForm, with horizontal slices separated and smeared in the vertical direction, achieving the desired magnification. Figure 8 illustrates the progress of the above algorithm in producing the magnified "7" shown in photo 1.

self   wideForm   wideForm   bigForm   bigForm

Figure 8: *Magnification with BitBlt. See the text for more details.*

Rotation

Another useful operation on images is rotation by a multiple of 90 degrees. Rotation is often thought to be a fundamentally different operation from translation, and this point of view would dismiss the possibility of using BitBlt to rotate an image. However, the reader must consent that the first transformation shown in figure 9 is a step toward rotating the image shown: all that remains is to rotate the insides of the four cells that have been permuted. The remainder of the figure shows each of these cells being further subdivided, its cells being similarly permuted, and so on. Eventually each cell being considered contains only a single pixel. At this point, no further subdivision is required, and the image has been faithfully rotated!

Each transformation shown in figure 9 would appear to require successively greater amounts of computation, with the last one requiring several times more than $h \times w$ operations. The tricky aspect of the algorithm below is to permute the subparts of every subdivided cell at once, thus performing the entire rotation in a constant times $log_2(h)$ operations. The parallel permutation of many cells is accomplished with the aid of two auxiliary Forms. The first, mask, carries a mask that selects the upper left quadrant of every cell; the second, temp, is used for temporary storage. A series of BitBlt operations exchanges the right and left halves of every cell, and then another series ex-



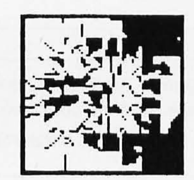
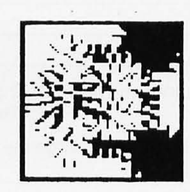
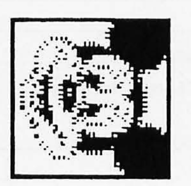
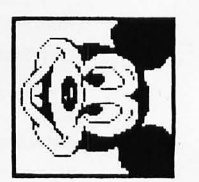
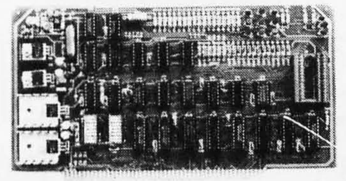






Figure 9: *Image rotation with BitBlt. See the text for more details.*

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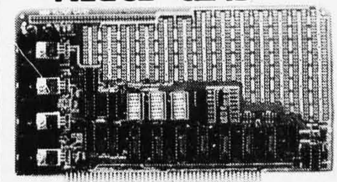


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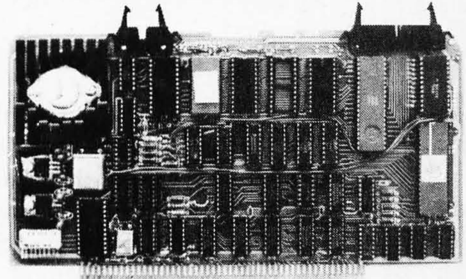


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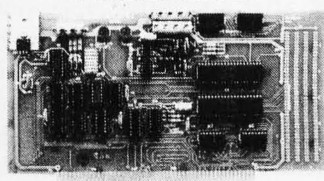
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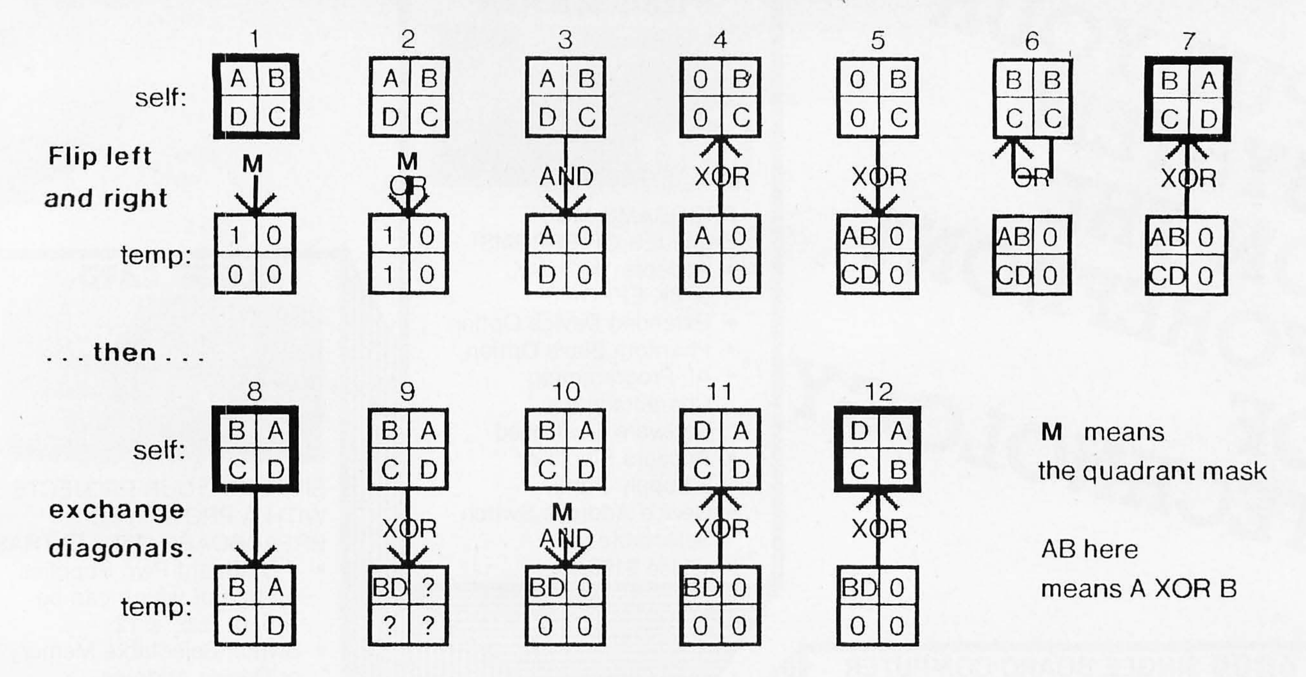


Figure 10: *Permuting four quadrants of a cell.*

changes the diagonal quadrants, achieving the desired permutation. The complete method for rotation is given in listing 4.

Figure 10 traces the state of temp and self after successive operations. The offsets of each operation are not shown, though they are given in the program listing. After twelve operations, the desired permutation has been achieved. At this point, the mask evolves to a finer grain, and the process is repeated for more, smaller cells. Figure 11 shows the evolution of the mask from the first to the second stage of refinement. The reader will note that the algorithm presented here for rotation is applicable only to square forms whose size is a power of two. The extension of this technique to arbitrary rectangles is more involved and is left as an exercise for the reader. A somewhat simpler exercise is to apply the above technique to horizontal and vertical reflections about the center of a rectangle.

The Game of Life

John Conway's game of Life is probably well known to readers of BYTE. It is a fairly simple rule for successive populations of a bitmap. The rule involves the neighbor count for each cell—how many of the eight adjacent cells are occupied? Each cell will be occupied in the next generation if it has exactly three neighbors, or if it was occupied and has exactly two neighbors. This is explained as follows: three neighboring organisms can give birth in an empty cell, and an existing organism will die of exposure with less than two neighbors or from overpopulation with more than three neighbors. Since BitBlt cannot add, it would seem to be of no use in this application. However, BitBlt's combination rules do include the rules for partial sum (XOR) and carry (AND). With some ingenuity and a fair amount of extra storage, the next generation of any size of bitmap can be computed using a *constant* number of BitBlt operations.

Listing 5 gives the method for nextLifeGeneration. As shown in figure 12, the number of neighbors is represented using three image planes for the 1s bit, 2s bit, and 4s bit of the neighbor count in binary. The 8s bit can be ignored, since there are no survivors in that case, which is equivalent to zero (the result of ignoring the 8s bit). This Smalltalk method is somewhat wasteful, as it performs the full carry propagation for each new neighbor, even though nothing will propagate into the 4-plane until at least the fourth neighbor. Some readers may enjoy improving upon this algorithm.

Many other image-processing tasks can be performed with BitBlt. The author has built a complete optical character-recognition system for Sanskrit text using the various combination rules and an operation that counts the number of black bits in any rectangle (how would you do it?).

Bitmap processing is ideally suited to VLSI (very large scale integration) implementation. Readers who are interested in this direction should check the proceedings of the Design Automation Conference, June 1981, for "Parallel Bitmap Processor," by Tom Blank, Mark Stefik, and Willem vanCleemput.

Efficiency Considerations

Our original specification for BitBlt has been published elsewhere

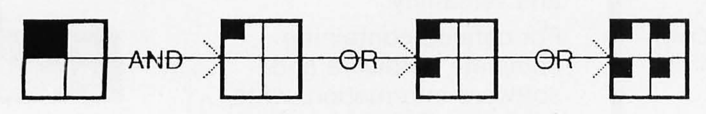
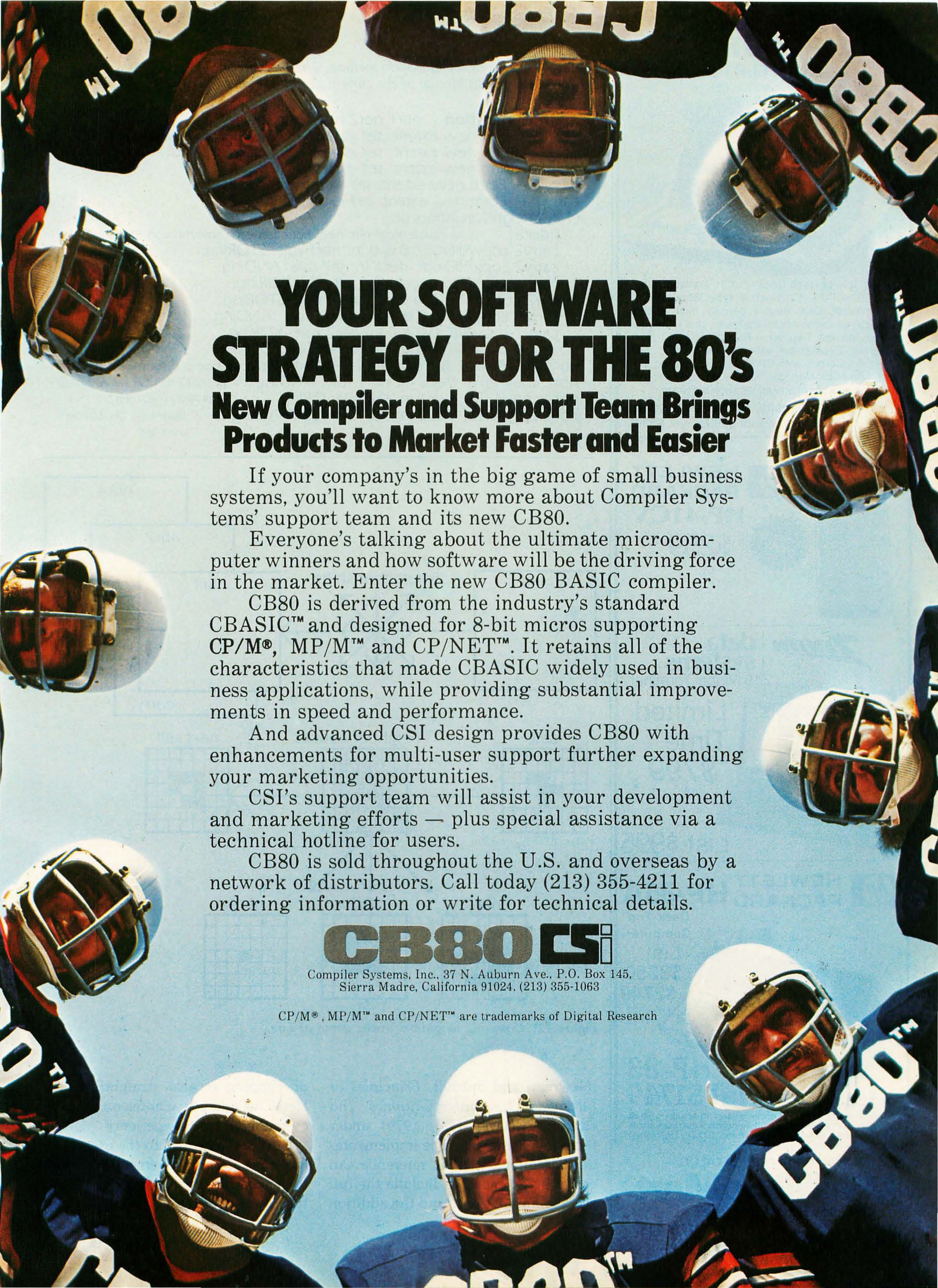


Figure 11: *Refinement of the quadrant mask.*

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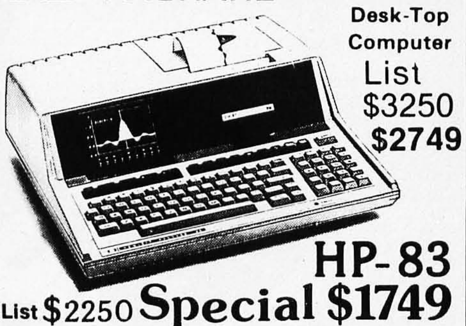
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Listing 5: *The* nextLifeGeneration *method. This method calculates the next Life generation given the BitBlt bitmap of the current generation. See figure 12.*

```
nextLifeGeneration | nbr1 nbr2 nbr4 carry2 carry4 |
  nbr1 ← Form new extent: self extent + (2 @ 2).      "temp areas larger by 1"
  nbr2 ← Form new extent: self extent + (2 @ 2).      "bit all around"
  nbr4 ← Form new extent: self extent + (2 @ 2).
  carry2 ← Form new extent: self extent + (2 @ 2).
  carry4 ← Form new extent: self extent + (2 @ 2).
  (1 @ 1) eightNeighbors do:
    [:delta | "delta equals a different neighbor-offset each time through this loop"
    carry2 copyAllFrom: 0 @ 0 in: nbr1 rule: STORing.
    carry2 copyAllFrom: delta in: self rule: ANDing.        "carry into 2"
    nbr1 copyAllFrom: delta in: self rule: XORing.          "sum 1"
    nbr2 copyAllTo: 0 @ 0 in: carry4 rule: STORing.
    carry2 copyAllTo: 0 @ 0 in: carry4 rule: ANDing.        "carry into 4"
    carry2 copyAllTo: 0 @ 0 in: nbr2 rule: XORing.          "sum 2"
    carry4 copyAllTo: 0 @ 0 in: nbr4 rule: XORing].         "sum 4"
  nbr2 copyAllTo: 1 @ 1 in: self rule: ANDing.  "perform logic to determine the survivors"
  nbr2 copyAllTo: 0 @ 0 in: nbr1 rule: ANDing.      "(2s AND self) OR (2s AND 1s))"
  nbr1 copyAllTo: 1 @ 1 in: self rule: ORing.       "...all AND (NOT 4s)"
  nbr4 copyAllTo: 0 @ 0 in: self rule: NOTANDing     "store next generation"
                                                     "over self"
```

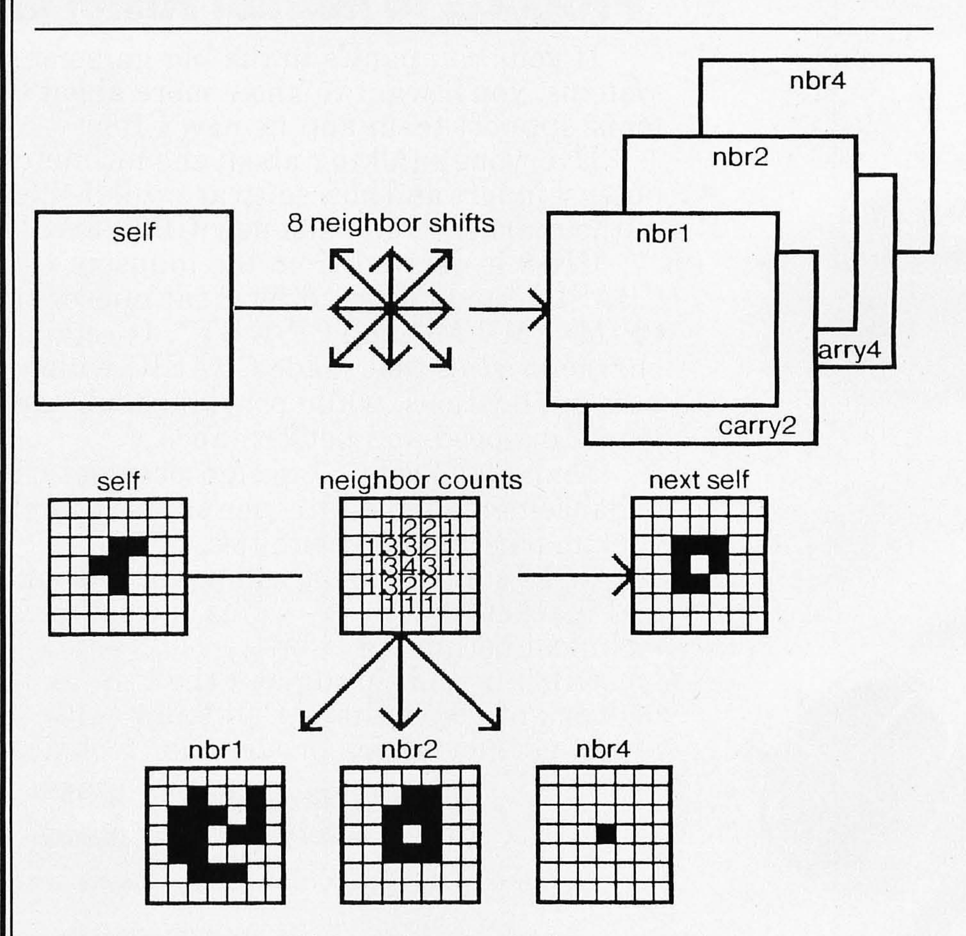


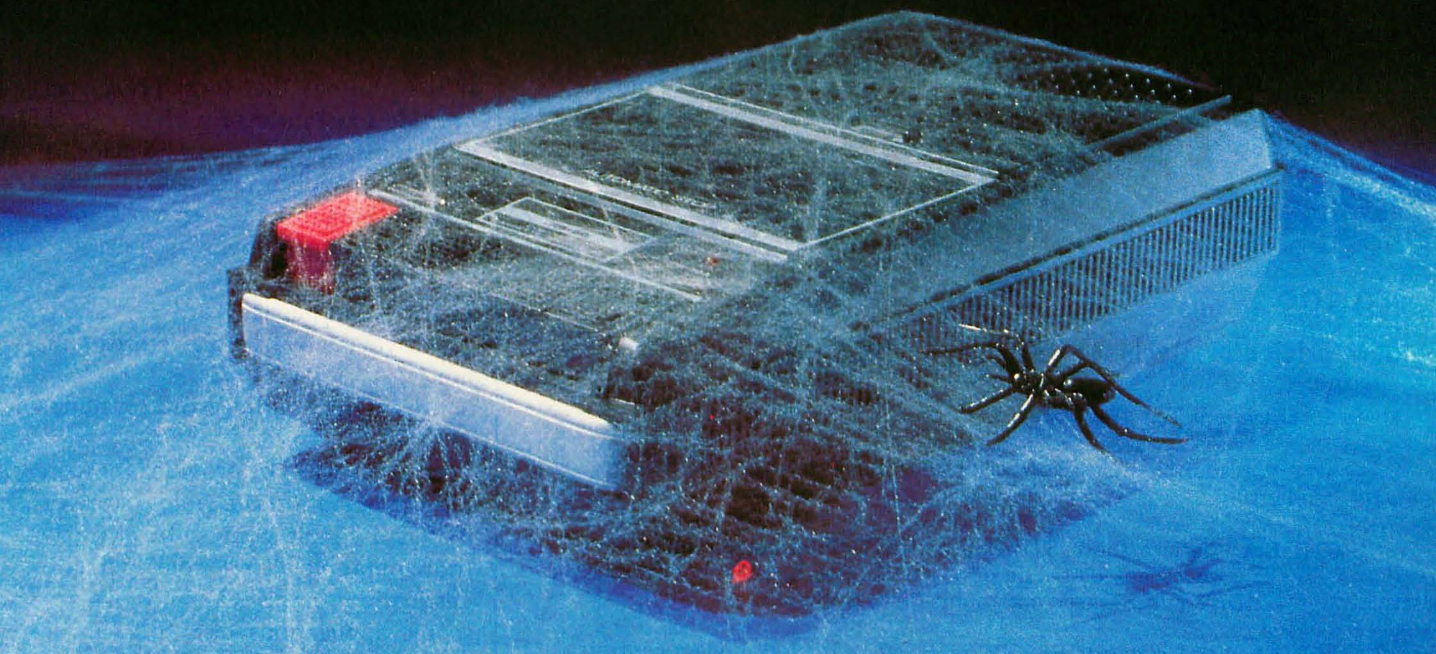
Figure 12: *Counting neighbors in the game of Life.*

(Newman and Sproull, *Principles of Interactive Computer Graphics*, 2nd edition, McGraw-Hill, 1979) under the name *RasterOp*. The implementation described in that reference can easily be extended to include the full set of combinations, and the addition of clipping is also straightforward. Here, we add a few notes on efficiency gathered from experience.

BitBlt is so central to the user interface that any improvement in its performance has considerable effect on the interactive quality of the system

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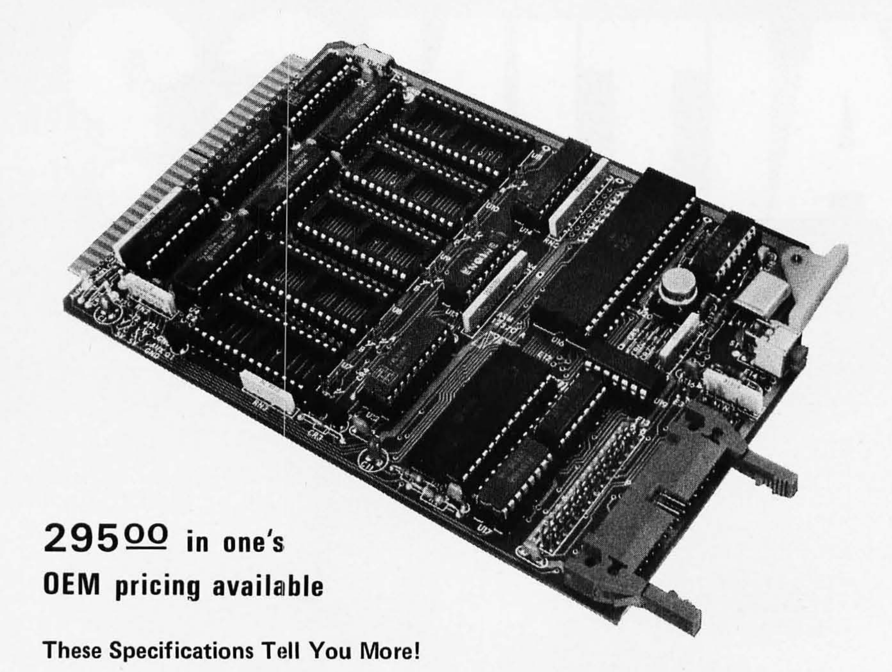


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as a whole. In normal use of the Smalltalk-80 system, most calls on BitBlt are either in the extreme microscopic or macroscopic range. Let us examine these more closely.

In the macroscopic range, the width of transfer spans many words. The inner loop across a horizontal scan line gets executed many times, and the operations requested tend to be simple moves or constant stores. Examples of these are:

- Clearing a line of text to white
- Clearing an entire window to white
- Scrolling a block of text up or down

It is fortuitous that most processors provide a fast means for block moves and stores, and these can be made to serve the applications above. Suppose we structure the horizontal loop of BitBlt as the following sequence:

1. Move left partial word
2. Move many whole words (or none)
3. Move right partial word (or none)

Special cases can be provided for item 2 if the operation is a simple store or if it is a simple copy with no skew (horizontal bit offset) from source to destination. In this way, most macroscopic applications of BitBlt can be made fast, even on processors of modest power.

The microscopic range of BitBlt is characterized by a zero count for the inner loop in item 2, so that the work on each scanline involves, at most, two words. Both overall setup and vertical loop overhead can be considerably reduced for this case. Because characters tend to be less than a word wide and lines tend to be less than a word thick, nearly all text and line drawing fall into this category. A convenient way to provide such efficiency is to write a special case of BitBlt that assumes the microscopic parameters, but goes to the general BitBlt whenever these are not met. Because of the statistics (many small operations and a few very large ones), it does not hurt to pay the penalty of a false assumption on infrequent calls. ■

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BYTE's Bits



Apple Displaces Organ at Wedding

The organ at St Bartholomew Church, Cincinnati, Ohio, stood idle at the wedding of Curt Brookbank and Libby Nieman, but the traditional wedding music of Wagner and Mendelssohn sounded as if an organist were hard at work. The organist was an Apple II. Ms Nieman, a buyer in the calculator department of the 21st Century Computer store in Cincinnati, decided on computerized wedding music after playing some computerized Christmas carols. The Apple II computer was equipped with ALF and Mountain music boards.

Old Altairs Never Die . . .

Five years ago, a computer built by students at Venice (California) High School began operation. Today that computer, and a duplicate built one semester later, are still operating. The computers, Altair 8800s, were built from kits for about $2000 each, which at the time was about a fourth of what an equivalent commercial computer would have cost. The school's principal at the time, Arnold Miller, agreed to buy the computer kits not only for the saving in cost but also for the educational value to the students who would build them and those who would use them.

The computers, running eight hours almost every day, have served hundreds of students in computer programming classes and in math classes. But the most enthusiastic users are those students who crowd the computer room before and after school and at other times to play computer games.

The student-built computers have been very reliable. They have never had a serious malfunction, requiring only the replacement of two integrated-circuit memory chips. The biggest maintenance problems have been mechanical, primarily the keyboards, which have taken a tremendous amount of pounding over their approximately 8000 hours of operation. It is estimated that total maintenance costs over five years for both Altairs have been less than $50.

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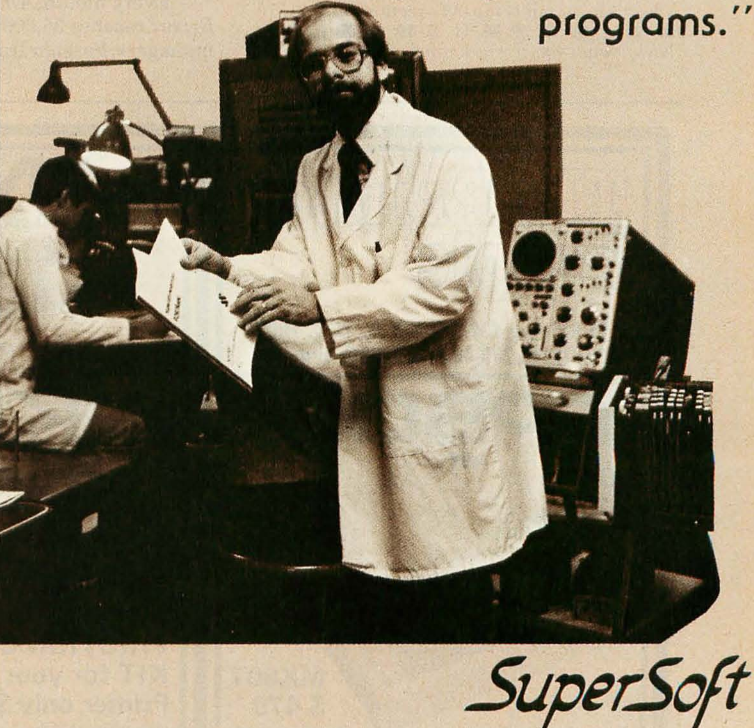
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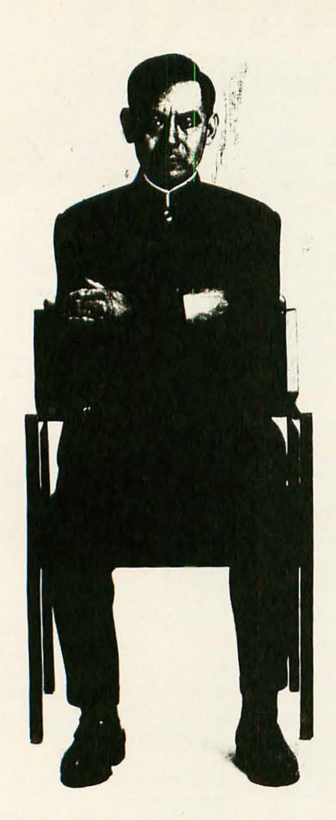
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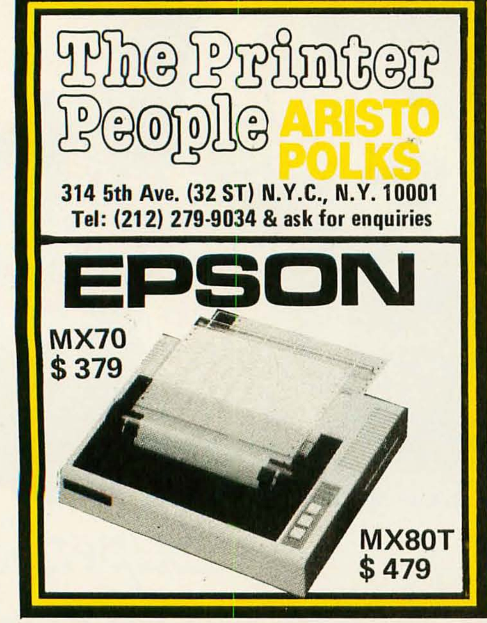
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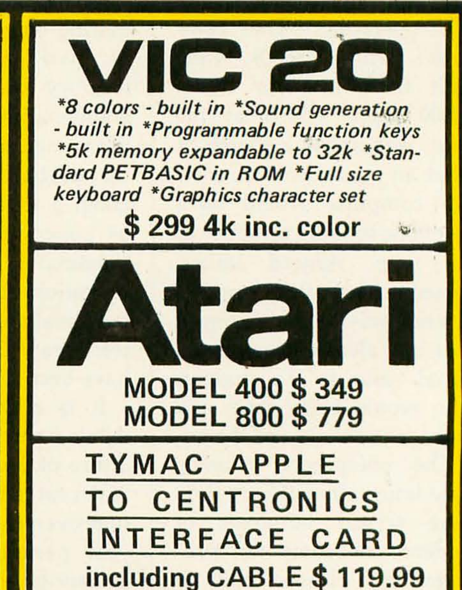
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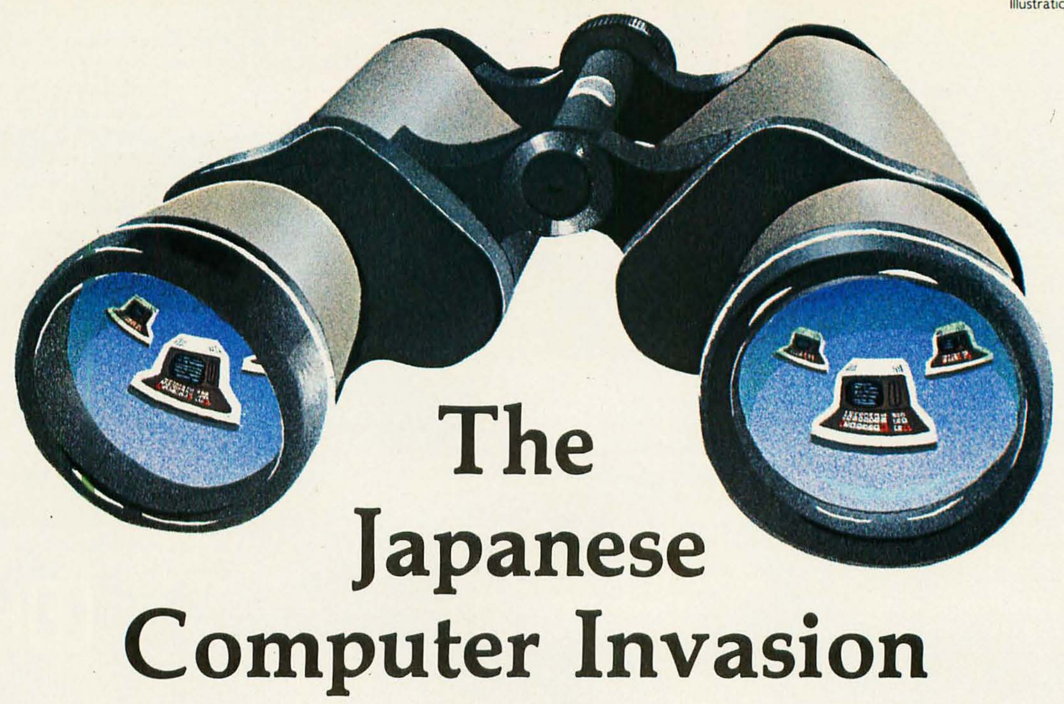
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Illustration by Jonathan Graves



The Japanese Computer Invasion

Stan Miastkowski, Technical Editor

Whenever computer-industry people get together these days the conversation inevitably turns to the so-called "Japanese Computer Invasion." From conversations I've overheard, it sometimes seems that there is an invasion fleet of Japanese ships off the West Coast, waiting to establish a beachhead in Silicon Valley.

Cutting through the paranoia, rumors, and just plain false information about the Japanese computer industry is a time-consuming and frustrating undertaking. It is further complicated by the intense secrecy of the Japanese, who, unlike their American counterparts, *never* talk off the record.

This article focuses on the Japanese companies who are (or soon will be) marketing personal computers in the United States. Make no mistake: Japanese computers *are* coming—with long-term implications for the American marketplace.

The Japanese Computer Industry

Contrary to popular belief, there is no such thing as "Japan Incorporated." Although many Americans view Japanese industry as one huge conglomerate working to take over foreign markets, the truth is that the Japanese computer industry is a group of fiercely competitive companies. It is that competition that fuels a rich variety of high-quality Japanese consumer electronic products.

Another strong reason for the quality of Japanese products is that in Japan a worker generally stays with one company throughout his or her working life. Unlike American industry, where labor and management are often at odds, Japanese workers feel a strong loyalty toward their employers, who pay them back with virtually guaranteed lifetime employment and carefully listen to their suggestions and complaints. This cooperation between management and labor produces a climate where each worker feels personally responsible for product quality.

Finally, one of the strongest points working in favor of the Japanese computer industry is that almost without exception the companies are vertically integrated—they control all aspects of the product, from manufacturing the silicon integrated circuits to marketing the products. This integration allows the Japanese to closely control costs and ensure product quality.

Fujitsu—the Company to Watch

Fujitsu Limited is the largest computer company in Japan, taking that coveted position by racking up $1.55 billion in computer sales during the year ending in April 1980. It edged past the Japanese subsidiary of IBM—which had sales of $1.54 billion during the same period. Although the margin was small, it gave the Japanese an important psychological boost—it was the first time that a Japanese computer company was number one in Japan. In the year ending this past April, Fujitsu pulled ahead even further.

Unlike the other Japanese conglomerates that have entered the computer market, Fujitsu's main business is computers. Although involved in a number of related fields, Fujitsu's interests do not seem to lie in the broad-ranging diversification of most of the other Japanese giants.

It would be a mistake not to think that Fujitsu is serious about the

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worldwide computer market. It owns 27.6% of Amdahl—the California-based manufacturer of IBM-compatible mainframe computers. It is also making strong inroads into the European market with its business ties to the West German electronics company Siemens. In contrast to other Japanese computer makers, who spend 5 to 6% of their sales on research and development, Fujitsu consistently sinks 10 to 12% of its sales into R & D. The company has come a long way since the early 1960s, when it approached IBM about a joint venture to design and build computers for the Japanese market. At that time IBM flatly turned them down.

The TRW/Fujitsu Connection

It's obvious that the United States will be the next target for Fujitsu. Early on, the company realized that it would have to have strong ties to US companies in order to compete in our market. One of the main reasons for this is that Fujitsu is an intensely *Japanese* company. Fujitsu's president rarely meets with foreigners and has broken off discussions in the past because of alleged breaches of Japan's strict business protocols.

The purchase of a partial interest in Amdahl was one of its first steps in the United States designed to create competition in the large-systems business. Fujitsu has also set up a marketing-service organization for its line of Winchester-technology hard-disk drives designed for small and medium systems. In fact, a low-cost 5¼-inch Winchester disk designed expressly for personal computers is expected to be available by the time you read this.

Last year, Fujitsu signed an agreement with another California-based company, TRW. Fujitsu agreed to supply computers, with TRW providing software development and support as well as a nationwide sales and service network.

The power of the TRW/Fujitsu connection cannot be overemphasized. TRW/Fujitsu Vice-President Garret Fitzgibbons told me the company plans a complete line of computers and peripherals aimed squarely at the personal and small-business markets. Late last year, the company displayed a prototype of a computer that was recently introduced. The Facom 9450, tentatively priced at $8000-plus, is an extremely powerful system with a custom-designed 16-bit microprocessor. Included in the price are an 80-column video display, two 5¼-inch floppy-disk drives, and a letter-quality printer.

The most revolutionary result of the TRW/Fujitsu connection is in its final development stage. Tentatively named the Bubcom 80, it is a machine that uses *bubble memory*, a technology that American companies have been reluctant to implement. (Bubble memory stores information in nonvolatile magnetic bubbles.)

The Bubcom 80 uses 32 K-byte memory cartridges; 128 K-byte cartridges are scheduled to be introduced in 1982. The computer is based around a Z80 microprocessor and comes with 64 K bytes of standard programmable memory. The Bubcom 80 runs CP/M and comes complete with an updated version of Microsoft BASIC.

Recently introduced in Japan, the Bubcom 80 sells for the equivalent of about $1200 with one bubble memory cartridge. Extra cartridges are about $130.

But that's not all from the people at Fujitsu/TRW. Their real personal computer blockbuster, soon to be introduced in the United States, is the Micro-8. This machine uses twin Motorola 6809 microprocessors to greatly increase speed, and the package includes full-color graphics. The Micro-8 has Microsoft's Extended Color BASIC (now available in the TRS-80 Color Computer) and will sell for about $1000.

In addition, a plug-in Z80 card will convert the Micro-8 into a CP/M machine. Also available are UCSD Pascal and the 32 K-byte bubble memory cartridges that will be standard in the Bubcom 80.

Early in March, a high-end

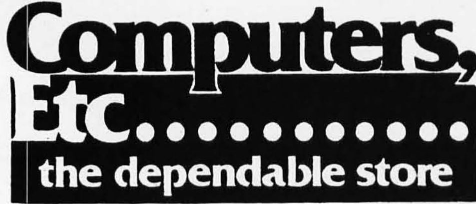
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As an example of what T/Maker II can do, see the chart below. The operator entered only the data shown in boldface. T/Maker II calculated and reported all the other values.

	— Actual —			Growth		Total	— Projected —		
	1978	1979	1980	Rate	Average	(000's)	1981	1982	1985
Item A	**42,323**	**51,891**	**65,123**	24.04	53,112	159.34	80,782	100,206	191,262
Item B	**45,671**	**46,128**	**49,088**	3.67	46,962	140.89	50,891	52,761	58,791
Total	87,994	98,019	114,211	13.93	100,075	300.22	131,673	152,966	250,053
% Item	48.10	52.94	57.02	8.88	52.69	158.1	61.35	65.51	76.49
% Item	51.90	47.06	42.98	-9.00	47.31	141.9	38.65	34.49	23.51
Total	100.00	100.00	100.00	—	100.00	300.0	100.00	100.00	100.00

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CARD GAMES

BRIDGE 2.0 (Available for all computers) Price: $17.95 Cassette/$21.95 Diskette
An all-inclusive version of this most popular of card games. This program both BIDS and PLAYS either contract or duplicate bridge. Depending on the contract, your computer opponents will either play the offense OR defense. If you bid too high, the computer will double your contract! BRIDGE 2.0 provides challenging entertainment for advanced players and is an excellent learning tool for the bridge novice. See the software review in 80 Software Critique.

HEARTS 1.5 (Available for all computers) Price: $15.95 Cassette/$19.95 Diskette
An exciting and entertaining computer version of this popular card game. Hearts is a trick-oriented game in which the purpose is not to take any hearts or the queen of spades. Play against two computer opponents who are armed with hard-to-beat playing strategies. HEARTS 1.5 is an ideal game for introducing the uninitiated (your spouse) to computers. See the software review in 80 Software Critique.

STUD POKER (Atari only) Price: $11.95 Cassette/$15.95 Diskette
This is the classic gambler's card game. The computer deals the cards one at a time and you (and the computer) bet on what you see. The computer does not cheat and *usually* bets the odds. However, it sometimes bluffs! Also included is a five card draw poker betting practice program. This package will run on a 16K ATARI. Color, graphics, sound.

POKER PARTY (Available for all computers) Price: $17.95 Cassette/$21.95 Diskette
POKER PARTY is a draw poker simulation based on the book, POKER, by Oswald Jacoby. This is the most comprehensive version available for microcomputers. The party consists of yourself and six other (computer) players. Each of these players (you will get to know them) has a different personality in the form of a varying propensity to bluff or fold under pressure. Practice with POKER PARTY before going to that expensive game tonight! Apple Cassette and diskette versions require a 32 K (or larger) Apple II.

CRIBBAGE 2.0 (TRS-80 only) Price: $14.95 Cassette/$18.95 Diskette
This is simply the best cribbage game available. It is an excellent program for the cribbage player in search of a worthy opponent as well as for the novice wishing to improve his game. The graphics are superb and assembly language routines provide rapid execution. See the software review in 80 Software Critique.

THOUGHT PROVOKERS

MANAGEMENT SIMULATOR (Atari, North Star and CP/M only) Price: $19.95 Cassette $23.95 Diskette
This program is both an excellent teaching tool as well as a stimulating intellectual game. Based upon similar games played at graduate business schools, each player or team controls a company which manufacturers three products. Each player attempts to outperform his competitors by setting selling prices, production volumes, marketing and design expenditures etc. The most successful firm is the one with the highest stock price when the simulation ends.

FLIGHT SIMULATOR (Available for all computers) Price: $17.95 Cassette/$21.95 Diskette
A realistic and extensive mathematical simulation of take-off, flight and landing. The program utilizes aerodynamic equations and the characteristics of a real airfoil. You can practice instrument approaches and navigation using radials and compass headings. The more advanced flyer can also perform loops, half-rolls and similar aerobatic maneuvers. Although this program does not employ graphics, it is exciting and very addictive. See the software review in COMPUTRONICS.

VALDEZ (Available for all computers) Price: $15.95 Cassette/$19.95 Diskette
VALDEZ is a computer simulation of supertanker navigation in the Prince William Sound/Valdez Narrows region of Alaska. Included in this simulation is a realistic and extensive 256 × 256 element map, portions of which may be viewed using the ship's alphanumeric radar display. The motion of the ship itself is accurately modelled mathematically. The simulation also contains a model for the tidal patterns in the region, as well as other traffic (outgoing tankers and drifting icebergs). Chart your course from the Gulf of Alaska to Valdez Harbor! See the software review in 80 Software Critique.

BACKGAMMON 2.0 (Atari, North Star and CP/M only) Price: $14.95 Cassette/$18.95 Diskette
This program tests your backgammon skills and will also improve your game. A human can compete against a computer or against another human. The computer can even play itself. Either the human or the computer can double or generate dice rolls. Board positions can be created or saved for replay. BACKGAMMON 2.0 is played in accordance with the official rules of backgammon and is sure to provide many fascinating sessions of backgammon play.

CHECKERS 3.0 (PET only) Price: $16.95 Cassette/$20.95 Diskette
This is one of the most challenging checkers programs available. It has 10 levels of play and allows the user to change skill levels at any time. Though providing a very tough game at level 4-8, CHECKERS 3.0 is practically unbeatable at levels 9 and 10.

CHESS MASTER (North Star and TRS-80 only) Price: $19.95 Cassette/$23.95 Diskette
This complete and very powerful program provides five levels of play. It includes castling, en passant captures and the promotion of pawns. Additionally, the board may be preset before the start of play, permitting the examination of "book" plays. To maximize execution speed, the program is written in assembly language (by SOFTWARE SPECIALISTS of California). Full graphics are employed in the TRS-80 version, and two widths of alphanumeric display are provided to accommodate North Star users.

NOMINOES JIGSAW (Atari, Apple and TRS-80 only) Price: $16.95 Cassette/$20.95 Diskette
A jigsaw puzzle on your computer! Complete the puzzle by selecting your pieces from a table consisting of 60 different shapes. NOMINOES JIGSAW is a virtuoso programming effort. The graphics are superlative and the puzzle will challenge you with its three levels of difficulty. Scoring is based upon the number of guesses taken and by the difficulty of the board set-up.

MONARCH (Atari only) Price: $11.95 Cassette/$15.95 Diskette
MONARCH is a fascinating economic simulation requiring you to survive an 8-year term as your nation's leader. You determine the amount of acreage devoted to industrial and agricultural use, how much food to distribute to the populace and how much should be spent on pollution control. You will find that all decisions involve a compromise and that it is not easy to make everyone happy.

CHOMP-OTHELLO (Atari only) Price: $11.95 Cassette/$15.95 Diskette
CHOMP-OTHELLO? It's really two challenging games in one. CHOMP is similar in concept to NIM; you must bite off part of a cookie, but avoid taking the poisoned portion. OTHELLO is the popular board game set to fully utilize the Atari's graphics capability. It is also very hard to beat! This package will run on a 16K system.

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STARTREK 3.2 (Available for all computers) Price: $11.95 Cassette/$15.95 Diskette
This is the classic Startrek simulation, but with several new features. For example, the Klingons now shoot at the Enterprise without warning while also attacking starbases in other quadrants. The Klingons also attack with both light and heavy cruisers and move when shot at! The situation is hectic when the Enterprise is besieged by three heavy cruisers and a starbase S.O.S. is received! The Klingons get even! See the software reviews in A.N.A.L.O.G., 80 Software Critique and Game Merchandising.

BLACK HOLE (Apple only) Price: $14.95 Cassette/$18.95 Diskette
This is an exciting graphical simulation of the problems involved in closely observing a black hole with a space probe. The object is to enter and maintain, for a prescribed time, an orbit close to a small black hole. This is to be achieved without coming so near the anomaly that the tidal stress destroys the probe. Control of the craft is realistically simulated using side jets for rotation and main thrusters for acceleration. This program employs Hi-Res graphics and is educational as well as challenging.

SPACE TILT (Apple and Atari only) Price: $10.95 Cassette/$14.95 Diskette
Use the game paddles to tilt the plane of the TV screen to "roll" a ball into a hole in the screen. Sound simple? Not when the hole gets smaller and smaller! A built-in timer allows you to measure your skill against others in this habit-forming action game.

MOVING MAZE (Apple only) Price: $10.95 Cassette/$14.95 Diskette
MOVING MAZE employs the games paddles to direct a puck from one side of a maze to the other. However, the maze is dynamically (and randomly) built and is continually being modified. The objective is to cross the maze without touching (or being hit by) a wall. Scoring is by an elapsed time indicator, and three levels of play are provided.

ALPHA FIGHTER (Atari only) Price: $14.95 Cassette/$18.95 Diskette
Two excellent graphics and action programs in one! ALPHA FIGHTER requires you to destroy the alien starships passing through your sector of the galaxy. ALPHA BASE is in the path of an alien UFO invasion; let five UFO's get by and the game ends. Both games require the joystick and get progressively more difficult the higher you score! ALPHA FIGHTER will run on 16K systems.

INTRUDER ALERT (Atari only) Price: $16.95 Cassette/$20.95 Diskette
This is a fast paced graphics game which places you in the middle of the "Dreadstar" having just stolen its plans. The droids have been alerted and are directed to destroy you at all costs. You must find and enter your ship to escape with the plans. Five levels of difficulty are provided. INTRUDER ALERT requires a joystick and will run on 16K systems.

GIANT SLALOM (Atari only) Price: $14.95 Cassette/$18.95 Diskette
This real-time action game is guaranteed addictive! Use the joystick to control your path through slalom courses consisting of both open and closed gates. Choose from different levels of difficulty, race against other players or simply take practice runs against the clock. GIANT SLALOM will run on 16K systems.

TRIPLE BLOCKADE (Atari only) Price: $14.95 Cassette/$18.95 Diskette
TRIPLE BLOCKADE is a two-to-three player graphics and sound action game. It is based on the classic video arcade game which millions have enjoyed. Using the Atari joysticks, the object is to direct your blockading line around the screen without running into your opponent(s). Although the concept is simple, the combined graphics and sound effect lead to "high anxiety".

GAMES PACK I (Available for all computers) Price: $10.95 Cassette/$14.95 Diskette
GAMES PACK I contains the classic computer games of BLACKJACK, LUNAR LANDER, CRAPS, HORSERACE, SWITCH and more. These games have been combined into one large program for ease in loading. They are individually accessed by a convenient menu. This collection is worth the price just for the DYNACOMP version of BLACKJACK.

GAMES PACK II (Available for all computers) Price: $10.95 Cassette/$14.95 Diskette
GAMES PACK II includes the games CRAZY EIGHTS, JOTTO, ACEY-DUCEY, LIFE, WUMPUS and others. As with GAMES PACK I, all the games are loaded as one program and are called from a menu. You will particularly enjoy DYNACOMP's version of CRAZY EIGHTS.

Why pay $7.95 or more per program when you can buy a DYNACOMP collection for just $10.95?

MOON PROBE (Atari only) Price: $11.95 Cassette/$15.95 Diskette
This is an extremely challenging "lunar lander" program. The user must drop from orbit to land at a predetermined target on the moon's surface. You control the thrust and orientation of your craft plus direct the rate of descent and approach angle.

ADVENTURE

CRANSTON MANOR ADVENTURE (North Star and CP/M only) Price: $21.95 Diskette
At last! A comprehensive Adventure game for North Star and CP/M systems. CRANSTON MANOR ADVENTURE takes you into mysterious CRANSTON MANOR where you attempt to gather fabulous treasures. Lurking in the manor are wild animals and robots who will not give up the treasures without a fight. The number of rooms is greater and the associated descriptions are much more elaborate than the current popular series of Adventure programs, making this game the top in its class. Play can be stopped at any time and the status stored on diskette.

ABOUT DYNACOMP

DYNACOMP is a leading distributor of small system software with sales spanning the world (currently in excess of 40 countries). During the past two years we have greatly enlarged the DYNACOMP product line, but have maintained and improved our high level of quality and customer support. The achievement in quality is apparent from our many repeat customers and the software reviews in such publications as COMPUTRONICS, 80 Software Critique and A.N.A.L.O.G. Our customer support is as close as your phone. It is always friendly. The staff is highly trained and always willing to discuss products or give advice.

**ATARI, PET, TRS-80, NORTHSTAR, CP/M and IBM are registered tradenames and/or trademarks.* ***TRS-80 diskettes are not supplied with DOS or BASIC.*

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BUSINESS and UTILITIES

SPELLGUARD™ (CP/M only) — **Price: $269.95 Disk**

SPELLGUARD is a revolutionary new product which increases the value of your current word processing system (WORDSTAR, MAGIC WAND, ELECTRIC PENCIL, TEXTED EDITOR II and others). Written entirely in assembly language, SPELLGUARD™ rapidly assists the user in eliminating spelling and typographical errors by comparing each word of the text against a dictionary (expandable) of over 20,000 of the most common English words. Words appearing in the text but not found in the dictionary are "flagged" for easy identification and correction. Most administrative staff familiar with word processing equipment will be able to use SPELLGUARD™ in only a few minutes.

MAIL LIST 2.2 (Apple, Atari and North Star diskette only) — **Price: $34.95**

This program is unmatched in its ability to store a maximum number of addresses on one diskette (minimum of 1100 per diskette, more than 2200 for "double density" systems!). Its many features include alphabetic and zip code sorting, label printing, merging of files and a unique keyword seeking routine which retrieves entries by a virtually limitless selection of user defined codes. Mail List 2.2 will even find and delete duplicate entries. A very valuable program!

FORM LETTER SYSTEM (FLS) (Apple and North Star diskette only) — **Price: $21.95**

Use FLS to create and edit form letters and address lists. Form letters are produced by automatically inserting each address into a predetermined portion of your letter. FLS is completely compatible with MAIL LIST 2.2, which may be used to manage your address files.

FLS and MAIL LIST 2.2 are available as a combined package for $49.95.

SORTIT (North Star only) — **Price: $29.95 Diskette**

SORTIT is a general purpose sort program written in 8080 assembly language. This program will sort sequential data files generated by NORTH STAR BASIC. Primary and optional secondary keys may be numeric or one to nine character strings. SORTIT is easily used with files generated by DYNACOMP's MAIL LIST program and is very versatile in its capabilities for all other BASIC data file sorting.

PERSONAL FINANCE SYSTEM (Atari and North Star only) — **Price: $34.95 Diskette**

PFS is a single diskette, menu-oriented system composed of ten different programs. Besides recording your expenses and tax deductible items, PFS will sort and summarize expenses by payee, and display information on expenditures by any of 26 user defined codes by month or by payee. PFS will even produce monthly bar graphs of your expenses by category! This powerful package requires only one disk drive, minimal memory (24K Atari, 32K North Star) and will store up to 600 records per disk (and over 1000 records per disk by making a few simple changes to the programs). You can record checks plus cash expenses so that you can finally see where your money goes and eliminate guesswork and tedious hand calculations.

FAMILY BUDGET (Apple only) — **Price: $34.95 Diskette**

The FAMILY BUDGET is a very convenient financial record-keeping program. You will be able to keep track of cash and credit expenditures as well as income on a daily basis. You can record tax deductible items and charitable donations. The FAMILY BUDGET also provides a continuous record of all credit transactions. You can make daily cash and charge entries to any of 21 different expense accounts as well as to 5 payroll and tax accounts. Data is easily retrieved giving the user complete control over an otherwise complicated (and unorganized!) subject.

THE COMMUNICATOR (Atari only) — **Price: $49.95 Diskette**

This software package contains a menu-driven collection of programs for facilitating efficient two-way communications through a full duplex modem (required for use). In one mode of operation you may connect to a data service (e.g., The SOURCE or MicroNet) and quickly load data such as stock quotations onto your diskette for later viewing. This greatly reduces "connect time" and thus the service charge. You may also record the complete contents of a communications session. Additionally, programs written in BASIC, FORTRAN, etc. may be built off-line using the support text editor and later "uploaded" to another computer, making the Atari a *very* smart terminal. Even Atari BASIC programs may be uploaded. Further, a command file may be built off-line and used later as controlling input for a time-share system. That is, you can set up your sequence of time-share commands and programs, and the Atari will transmit them as needed; batch processing. All this adds up to saving both connect time and your time.

DYNACOMP also supplies THE COMMUNICATOR with an Atari 830 modem for a combined price of $219.95. The modem is available separately for $189.95.

TEXT EDITOR II (CP/M) — **Price: $29.95 Diskette/$33.45 Disk**

This is the second release version of DYNACOMP's popular TEXT EDITOR I and contains many new features. With TEXT EDITOR II you may build text files in chunks and assemble them for later display. Blocks of text may be appended, inserted or deleted. Files may be saved on disk/diskette in right justified/centered format to be later printed by either TEXT EDITOR II or the CP/M ED facility. Futher, ASCII CP/M files (including BASIC and assembly language programs) may be read by the editor and processed. In fact, text files can be built using ED and later formatted using TEXT EDITOR II. All in all, TEXT EDITOR II is an inexpensive, easy to use, but very flexible editing system.

DFILE (North Star only) — **Price: $19.95**

This handy program allows North Star users to maintain a specialized data base of all files and programs in the stack of disks which invariably accumulates. DFILE is easy to set up and use. It will organize your disks to provide efficient locating of the desired file or program.

FINDIT (North Star only) — **Price: $19.95**

This is a three-in-one program which maintains information accessible by keywords of three types: Personal (eg: last name), Commercial (eg: plumbers) and Reference (eg: magazine articles, record albums, etc). In addition to keyword searches, there are birthday, anniversary and appointment searches for the personal records and appointment searches for the commercial records. Reference records are accessed by a single keyword or by cross-referencing two or three keywords.

GRAFIX (TRS-80 only) — **Price: $14.95 Cassette/$18.95 Diskette**

This unique program allows you to easily create graphics directly from the keyboard. You "draw" your figure using the program's extensive cursor controls. Once the figure is made, it is automatically appended to your BASIC program as a string variable. Draw a "happy face", call it H$ and then print it from your program using PRINT H$! This is a very easy way to create and save graphics.

EDUCATION

HODGE PODGE (Apple only, 48K Applesoft or Integer BASIC) — **Price: $19.95 Cassette/$23.95 Diskette**

Let HODGE PODGE be your child's baby sitter. Pressing any key on your Apple will result in a different and intriguing "happening" related to the letter or number of the chosen key. The program's graphics, color and sound are a delight for children from ages 1½ to 9. HODGE PODGE is a non-intimidating teaching device which brings a new dimension to the use of computers in education.

TEACHER'S PET I (Available for all computers) — **Price: $11.95 Cassette/$15.95 Diskette**

This is the first of DYNACOMP's educational packages. Primarily intended for pre-school to grade 3, TEACHER'S PET provides the young student with counting practice, letter-word recognition and three levels of math skill exercises.

MORSE CODE TRAINER (TRS-80 only) — **Price: $12.95 Cassette/$16.95 Diskette**

MORSE CODE TRAINER is designed to develop and improve your speed and accuracy in deciphering Morse Code. As such, MCT is an ideal software package for FCC test practice. The code sound is obtained through the earphone jack of any standard cassette recorder. You may choose the pitch of the tones as well as the word rate. Also, various modes of operation are available including number, punctuation and alphabet tests, as well as the keying of your own message. A very effective way to learn code!

MISCELLANEOUS

CRYSTALS (Atari only) — **Price: $ 9.95 Cassette/$13.95 Diskette**

A unique algorithm randomly produces fascinating graphics displays accompanied with tones which vary as the patterns are built. No two patterns are the same, and the combined effect of the sound and graphics are mesmerizing. CRYSTALS has been used in local stores to demonstrate the sound and color features of the Atari.

NORTH STAR SOFTWARE EXCHANGE (NSSE) LIBRARY

DYNACOMP now distributes the 23 volume NSSE library. These diskettes each contain many programs and offer an outstanding value for the purchase price. They should be part of every North Star user's collection. Call or write DYNACOMP for details regarding the contents of the NSSE collection.

Price: $9.95 each/$7.95 each (4 or more)
The complete collection may be purchased for $149.95

AVAILABILITY

DYNACOMP software is supplied with complete documentation containing clear explanations and examples. Unless otherwise specified, all programs will run within 16K program memory space (ATARI requires 24K). Except where noted, programs are available on ATARI, PET, TRS-80 (Level II) and Apple (Applesoft) cassette and diskette as well as North Star single density (double density compatible) diskette. Additionally, most programs can be obtained on standard (IBM format) 8" CP/M floppy disks for systems running under MBASIC.

STATISTICS and ENGINEERING

DIGITAL FILTER (Available for all computers) — **Price: $29.95 Cassette/$33.95 Diskette**

DIGITAL FILTER is a comprehensive data processing program which permits the user to design his own filter function or choose from a menu of filter forms. The filter forms are subsequently converted into non-recursive convolution coefficients which permit rapid data processing. In the explicit design mode the shape of the frequency transfer function is specified by directly entering points along the desired filter curve. In the menu mode, ideal low pass, high pass and bandpass filters may be approximated to varying degrees according to the number of points used in the calculation. These filters may optionally also be smoothed with a Hanning function. In addition, multi-stage Butterworth filters may be selected. Features of DIGITAL FILTER include plotting of the data before and after filtering, as well as display of the chosen filter functions. Also included are convenient data storage, retrieval and editing procedures.

DATA SMOOTHER (Not available for Atari) — **Price: $14.95 Cassette/$18.95 Diskette**

This special data smoothing program may be used to rapidly derive useful information from noisy business and engineering data which are equally spaced. The software features choice in degree and range of fit, as well as smoothed *first* and *second* derivative calculation. Also included is automatic plotting of the input data and smoothed results.

FOURIER ANALYZER (Available for all computers) — **Price: $16.95 Cassette/$20.95 Diskette**

Use this program to examine the frequency spectra of limited duration signals. The program features automatic scaling and plotting of the input data and results. Practical applications include the analysis of complicated patterns in such fields as electronics, communications and business.

TFA (Transfer Function Analyzer) — **Price: $19.95 Cassette/$23.95 Diskette**

This is a special software package which may be used to evaluate the transfer functions of systems such as hi-fi amplifiers and filters by examining their response to pulsed inputs. TFA is a major modification of FOURIER ANALYZER and contains an engineering-oriented decibel versus log-frequency plot as well as data editing features. Whereas FOURIER ANALYZER is designed for educational and scientific use, TFA is an engineering tool. Available for all computers.

HARMONIC ANALYZER (Available for all computers) — **Price: $24.95 Cassette/$28.95 Diskette**

HARMONIC ANALYZER was designed for the spectrum analysis of repetitive waveforms. Features include data file generation, editing and storage/retrieval as well as data and spectrum plotting. One particularly unique facility is that the input data need not be equally spaced or in order. The original data is sorted and a cubic spline interpolation is used to create the data file required by the FFT algorithm.

FOURIER ANALYZER, TFA and HARMONIC ANALYZER may be purchased together for a combined price of $49.95 (three cassettes) and $59.95 (three diskettes).

REGRESSION I (Available for all computers) — **Price: $19.95 Cassette/$23.95 Diskette**

REGRESSION I is a unique and exceptionally versatile one-dimensional least squares "polynomial" curve fitting program. Features include very high accuracy; an automatic degree determination option; an extensive internal library of fitting functions; data editing; automatic data and curve plotting; a statistical analysis (eg: standard deviation, correlation coefficient, etc.) and much more. In addition, new fits may be tried without reentering the data. REGRESSION I is certainly the cornerstone program in any data analysis software library.

REGRESSION II (PARAFIT) (Available for all computers) — **Price: $19.95 Cassette/$23.95 Diskette**

PARAFIT is designed to handle those cases in which the parameters are imbedded (possibly nonlinearly) in the fitting function. The user simply inserts the functional form, including the parameters (A(1), A(2), etc.) as one or more BASIC statement lines. Data and results may be manipulated and plotted as with REGRESSION I. Use REGRESSION I for polynomial fitting, and PARAFIT for those complicated functions.

MULTILINEAR REGRESSION (MLR) (Available for all computers) — **Price: $24.95 Cassette/$28.95 Diskette**

MLR is a professional software package for analyzing data sets containing two or more linearly independent variables. Besides performing the basic regression calculation, this program also provides easy to use data entry, storage, retrieval and editing functions. In addition, the user may interrogate the solution by supplying values for the independent variables. The number of variables and data size is limited only by the available memory.

REGRESSION I, II and MULTILINEAR REGRESSION may be purchased together for $51.95 (three cassettes) or $63.95 (three diskettes).

ANOVA (Available for all computers) — **Price: $39.95 Cassette/$43.95 Diskette**

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BASIC SCIENTIFIC SUBROUTINES, Volume I (Not available for Atari)

DYNACOMP is the exclusive distributor for the software keyed to the popular text *BASIC Scientific Subroutines, Volume I* by F. Ruckdeschel (see the BYTE/McGraw-Hill advertisement in BYTE magazine, January 1981). These subroutines have been assembled according to chapter. Included with each collection is a menu program which selects and demonstrates each subroutine.

Collection #1: Chapters 2 and 3: Data and function plotting, complex variables
Collection #2: Chapter 4: Matrix and vector operations
Collection #3: Chapters 5 and 6: Random number generators, series approximations
Price per collection: $14.95 Cassette/$18.95 Diskette

All three collections are available for $39.95 (three cassettes) and $49.95 (three diskettes).
Because the text is a vital part of the documentation, *BASIC Scientific Subroutines, Volume I* is available from DYNACOMP for $19.95 plus 75¢ postage and handling.

ROOTS (Available for all computers) — **Price $10.95 Cassette/$14.95 Diskette**

In a nutshell, ROOTS simultaneously determines all the zeroes of a polynomial having real coefficients. There is no limit on the degree of the polynomial, and because the procedure is iterative, the accuracy is generally very good. No initial guesses are required as input, and the calculated roots are substituted back into the polynomial and the residuals displayed.

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ACAP is easy to learn and use. Simply describe the circuit in terms of the elements and their placement, and execute. Circuit descriptions may be saved onto cassette or diskette to be recalled at a later time for execution or editing. ACAP should be part of every circuit designer's program library.

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Text continued from page 202:
business microcomputer was announced by TRW/Fujitsu. The TFC-8500 system starts at $25,000 and goes upward to $200,000. In addition, the company will market a line of point-of-sale computer cash registers/terminals. This market is very competitive at the present time.

It's obvious that there is a large amount of activity going on behind the scenes at both TRW and Fujitsu—two companies to watch carefully.

Sharp Electronics

Although not in the multibillion-dollar league of many of the companies we're discussing here, Sharp is one of the most well known in the United States. Its wide-ranging line of calculators and other consumer electronics products is sold by approximately 1400 dealers in the States. Consequently, the company has a great deal of marketing experience here as well as an extremely strong sales and service network.

Over the past few years, Sharp's calculator products have become more and more sophisticated; therefore, it's not surprising that its first personal computer resembled a calculator. It's interesting that instead of marketing the product itself, Sharp sold initial marketing rights to the company with one of the largest sales and service networks in the world—Radio Shack.

The Sharp PC-1211 Pocket Computer became the TRS-80 Pocket Computer, introduced in August 1980 by Radio Shack. By using the immense marketing power of Radio Shack, Sharp was "testing the waters." A source at Sharp told me the company had doubts about how the product would be received.

To say the reception was good is an understatement. Sales of the TRS-80 Pocket Computer during its first six months were estimated at 40,000 units—four times the Radio Shack sales projections. The company initially purchased approximately 10,000 units, creating supply problems shortly after introduction.

Radio Shack's exclusive marketing rights to the PC-1211 ran out in March 1981. Sharp has started marketing the Pocket Computer with the addition of a printer although Radio Shack will also offer a printer in the near future.

Some observers of the personal computer market feel pocket computers are only a novelty—a fad that will soon pass. However, a number of companies seem committed to their development. Although presently limited in utility, pocket computers will be a major factor in the popularization of personal computers.

In the meantime, Sharp has aimed squarely at the small-business market with the recent introduction of the YX-3200. The system is being sold by 720 Sharp dealers and will retail in the $6000 range. The powerful Z80-based system includes a 12-inch green-phosphor display (80-characters) and two 5¼-inch quad-density floppy-disk drives. Also included in the price is an Epson MX-80 printer (manufactured by a Japanese subsidiary of Seiko). An interesting sidelight is that the YX-3200 was designed in the United States—by American engineers.

The marketing of the YX-3200 system will also be an experiment. Sharp has projected sales of 5000 systems by April 1982. It will be virtually the first computer system to be sold by persons who are *not* computer dealers. The majority of Sharp salesmen chosen to sell the system are office equipment dealers. As the small-business market continues to grow, we are likely to see more and more personal computer systems sold in this way.

In the realm of the truly personal computer, the MZ-80 is perhaps the most interesting part of the Sharp line. Not currently available in the United States, it is one of the largest-selling personal computers in Europe and Japan. The MZ-80 retails for approximately $900 with a calculator-style keyboard (not unlike the early PET), $1200 with a standard keyboard. It's an attractive machine

Text continued on page 212

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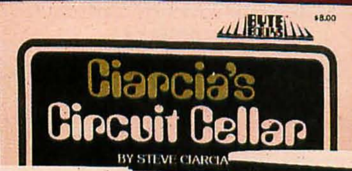
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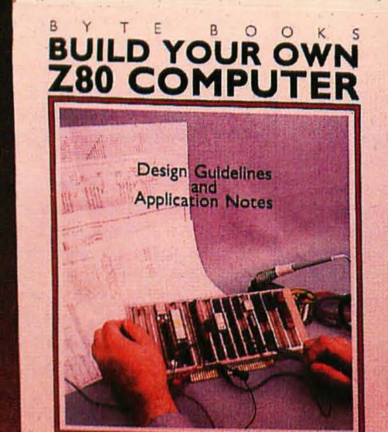
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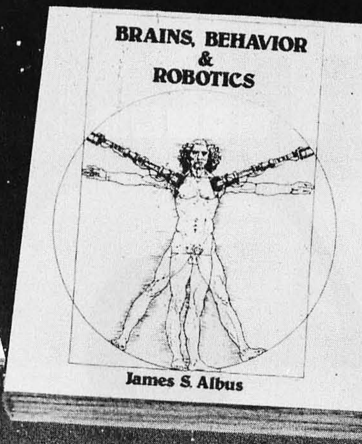
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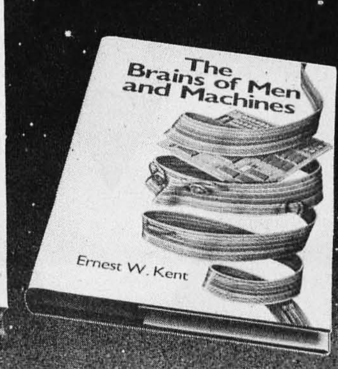
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John Whitney is on the Faculty in the Department of Art at the University of California, Los Angeles.

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Scott Kim is a doctoral student in Computer Science at Stanford University and is a concert pianist and composer.

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Dr. James S. Albus is Project Manager with the National Bureau of Standards.

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Dr. Ernest W. Kent is a Professor of Physiological Psychology and Psychopharmacology at the University of Illinois at the Chicago Circle Campus.

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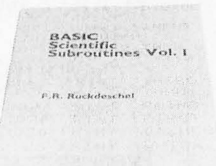
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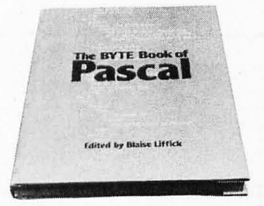
Dr. Fred Ruckdeschel is a Principal Scientist with Dynacomp, Inc.

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Blaise W. Liffick, Editor

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by Ronald Loeliger



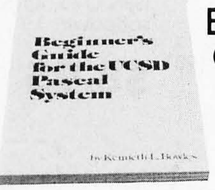
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Ron Loeliger is a Senior Analyst with Intermetrics, Inc.

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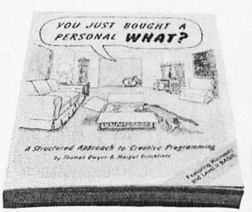
Dr. Kenneth L. Bowles is Director of the Institute for Information Systems, University of California, San Diego.

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by Thomas Dwyer and Margot Critchfield



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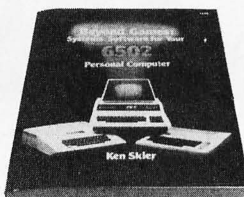
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Dr. Thomas Dwyer is a Professor of Computer Science at the University of Pittsburgh.

Margot Critchfield is a doctoral student in Foundations in Education at the University of Pittsburgh.

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Kenneth Skier is a Systems Programmer for Wang Laboratories, Inc., and a Lecturer at MIT.

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Dr. Henry D'Angelo is the Associate Dean of the College of Engineering and Professor of Manufacturing Engineering at Boston University.

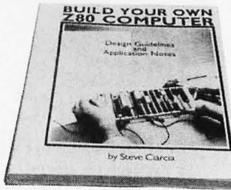
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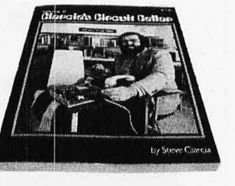
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Steve Ciarcia is a Computer Consultant, Electrical Engineer, and author of "Ask Byte" and "Ciarcia's Circuit Cellar" columns in BYTE magazine.

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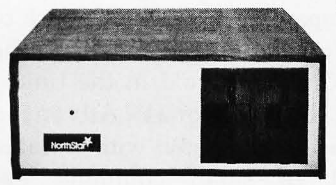
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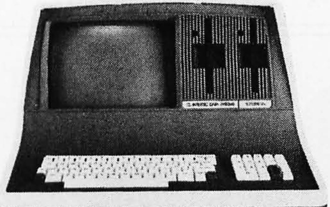
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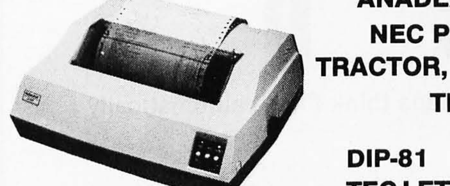


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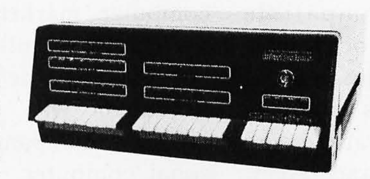
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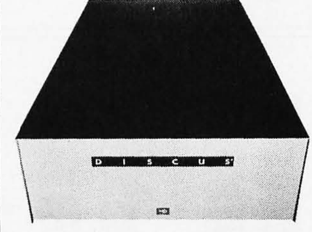
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Text continued from page 206:
designed with the consumer in mind. The keyboard, 10-inch black-and-white display, and a cassette recorder are all contained in a single compact package. The MZ-80 is based around a Z80 microprocessor and includes 16 K bytes of programmable memory, Microsoft-compatible BASIC, a real-time clock, and sound/music capabilities. Dual 5¼-inch floppy-disk drives as well as a variety of printers are also being sold by Sharp in Europe and Japan, making the MZ-80 a powerful low-end business machine.

Sharp officials deny there are any plans afoot to market the MZ-80 in the United States. My personal feeling is that it will make its appearance here soon. The existing Sharp dealers network is the ideal place to market a machine such as this—designed for the *consumer*.

Hitachi

Hitachi is yet another of the multibillion-dollar Japanese giants. 1980 sales of $13.4 billion make it the fifth largest company in Japan. Long known for high-quality inexpensive consumer electronics equipment (sold under a variety of names in the United States), Hitachi seemed to be one of the first to plan a marketing strategy to crack the US personal computer market. The problem is that, until recently, it never became serious about the plan.

Hitachi was one of the first Japanese companies to build a personal computer. The HD46800 was announced in June 1978 and was a true *home* computer designed for environmental control, menu and financial planning, as well as burglar and fire alarm interfacing. But it was too much, too soon. The US personal computer market was then only beginning to develop with the introduction of the first Radio Shack TRS-80 models.

Another major problem with Hitachi is the lack of a marketing organization in the United States. There seems to be little movement in the direction of developing one. Lately, the company appears to be concentrating on large computers to compete in the IBM mainframe market. Hitachi recently introduced the AS-9000 computer with features far and above IBM's largest computer at a comparable price. But the lack of a US organization has hurt. The AS-9000 is being sold in the United States by National Advanced Systems—a company with a large amount of small computer experience. Although the AS-9000 is receiving a very favorable response, service is already a major problem. Recently, Lockheed Dialog installed an AS-9000 in its well-known database system. It was learned recently that a strange bug caused the entire system to crash at random intervals. Servicing the AS-9000 required that engineers be brought in from Japan, an extremely expensive proposition for Hitachi.

Even with the lack of a US organization, it seems certain that Hitachi will begin a major drive to in-

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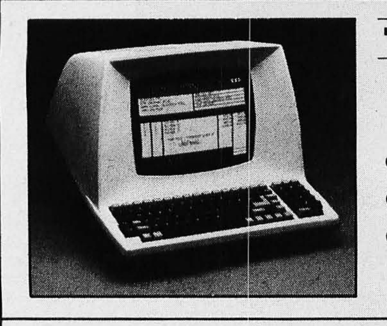
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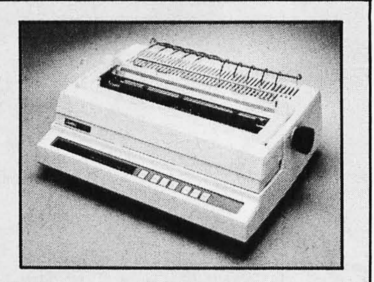
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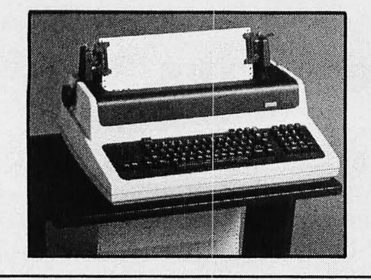
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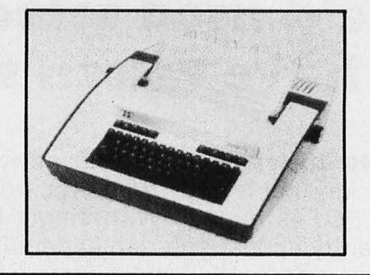
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troduce its personal computers here. The Hitachi BASIC Master Level III is now being sold in Japan and will probably soon be test-marketed in the United States. Based on a Motorola 6809 microprocessor, the unit has Microsoft BASIC, 80-column text display, and high-resolution graphics with six colors available. The US price is expected to be in the $1500 range. A special color monitor for ultra-high-resolution graphics is $900.

Hitachi seems to be making a slow but steady penetration into the personal computer market. Although it probably won't be a strong force in the US for a few years, Hitachi's heavy R & D expenditures and quality-at-low-cost reputation make it a strong long-term prospect for major US sales.

NEC

Nippon Electric Company is poised for a major move into the US computer market in *both* the personal and small-business markets.

NEC's trump card is the *PC-8001*, the largest-selling personal computer in Japan (some 3000 to 4000 units are sold monthly). The details of the PC-8001 were covered in an article in the January 1981 BYTE (page 72). It was first shown at the 1980 NCC (National Computer Conference). In January 1981, it was featured at the winter Consumer Electronics Show. NEC's Consumer Electronics Division, based in Elk Grove Village, Illinois, is now marketing it in the US through major personal computer dealers. The base price is $1295 with 32 K bytes of programmable memory. (A little-known fact about the PC-8001 is that it was jointly developed by NEC and an Arlington Heights, Ohio, company called Just Another Computer Company.)

The major strength of the PC-8001 is that it has something for everyone: dazzling color graphics for the consumer as well as strong computation power and a full line of peripherals for business people.

The key to the unit's success will be its marketing. The NEC name is not well known in the United States and,

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at present, no large-scale organization exists to support it. However, NEC's marketing manager says the company will have a number of computer distributors and retail outlets in the near future.

NEC is also aiming at the higher end of the small-business market with the Astra system, which is expected to be available soon. NEC Information Systems (Lexington, Massachusetts) is marketing the system, with prices starting at $11,000.

Casio

Relatively small (by Japanese standards) Casio is well known for its extensive line of calculators (many sold under different brand names). Casio has had its ups and downs over the past few years and developed a personal computer about three years ago. Although some were sold in Japan, the product was ahead of its time.

Casio is about to make a major bid for the US personal and small-business computer market with the imminent introduction of the FX-9000P.

The FX-9000P has a unique design with a built-in green phosphor 5-inch monitor (similar to the Hewlett-Packard HP-83 and HP-85). One of the most interesting features is the set of plug-in modules for programmable memory expansion, peripheral interface, and software in read-only memory. In addition, the unit will be one of the first to partially use CMOS memory (which doesn't lose data when the power is turned off). As CMOS prices continue to fall, more companies will incorporate this new technology in their computer designs.

The big question mark about the FX-9000P is the price. Although company officials were more than happy to talk about its capabilities, the price is something they refused to even hint at. The unit seems to be aimed at more specialized uses than personal computers made by others. It will probably be marketed for scientific as well as small-business uses—aggressive pricing, however, will make it attractive for lower-end uses. The best guess is that it will sell in the $1200 to $1800 range.

Mitsubishi

Another of the giant Japanese conglomerates, Mitsubishi, builds everything from small consumer applicances to jet planes. The company is one of the few that doesn't (at the moment) seem to be interested in the personal computer market, but its large mainframe systems make it the fifth largest computer company in Japan.

Mitsubishi does have a US subsidiary which is working to market a high-end small-business computer. Melcom systems is expected to market the Melcom Model 18 soon. The system is already being sold in Japan with prices starting at $18,000.

Rumors about a Mitsubishi personal computer are nonexistent, but the fact that it is developing a computer marketing network portends things to come.

Seiko

Best known for its line of watches, Seikosha Limited has been rumored for some time to be developing a low-end portable personal computer. Since 1979, the company has been selling a personal computer in Japan (with very limited success). The Seikosha 8500 uses two Intel 8085 microprocessors, has a 12-inch video display, and comes with two 5¼-inch floppy-disk drives. Chances are slim that this product will ever arrive on the American market.

The hottest rumor, circulating for some time now, is that Seiko's low-end personal computer would have a "designer" look created by Pierre Cardin. At the winter Consumer Electronics Show, Seiko displayed a number of products designed by Cardin. Conversations with Seiko personnel brought out the fact that "other products" are under development and will soon be appearing here.

Perhaps the biggest argument for an eventual Seiko push into the US personal computer market is the success of Seiko's Epson subsidiary. Epson printers are rapidly becoming more and more popular in the United States, with a sales and service organization that is building rapidly—an organization that could

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Matsushita

Matsushita is one of the largest manufacturers and marketers of consumer electronics products in the world, with 1980 sales of $13.7 billion. In the United States, the company is best known for the Quasar, Panasonic, and Technics brands. Its US marketing organization and expertise are formidable.

Apparently, the company's first thought about entering the US personal computer market was to approach it in a very different way—namely, the Panasonic and Quasar hand-held computer, introduced officially at the winter Consumer Electronics Show. (See BYTE January 1981, page 34.)

Persistent rumors exist in the industry that Matsushita is having second thoughts about the hand-held computer in its present form. Release dates have already been pushed up a few months, lending credence to the rumor that the product will undergo a major redesign. Meanwhile, there are reports that the company is hard at work on a full-sized personal computer in the $1000 range.

IBM obviously respects the resources of Matsushita in the small computer field; Matsushita officials recently admitted they were approached by IBM to build a personal computer for the US giant. Sources at both companies say nothing came of the meeting, but, in fact, Matsushita and IBM having been working for some time on a joint project to produce a series of personal computers bearing the IBM logo. Code-named "Go," the project now seems to have been suspended. (See the editorial in last month's BYTE.)

Sord

Although virtually unknown in the United States, this small company based in Tokyo is planning a major push into the US market. Sord designed and markets the M100 computer in both Europe and Japan. Some 1800 units were reportedly shipped to Europe in 1980. They are evidently being sold under another name because dealers contacted in the United Kingdom had never heard of them.

Most Japanese companies are secretive, but Sord stands out as one of the most tight-lipped. I was consistently unable to contact company officials and letters went unanswered. Consequently, details of the M100 are not available.

There are, however, persistent rumors that the company will appear suddenly in the US with a strong product, marketed well.

Other Companies

A number of other Japanese companies are working on personal and small-business computers designed for the United States market. In most of the following cases, little if any details are available.

Sony recently admitted it is designing a personal computer which will either interface with or be designed around its recently introduced TypeCorder portable typewriter (which fits in a briefcase and stores text on miniature tape cassettes). Sony has what is probably the most formidable marketing/service organization of any Japanese company in the United States. More importantly, the Sony name is synonymous with high quality and innovative technology.

Expect the introduction of a Sony personal computer within a year. It will probably be unlike any other product now on the market and will use Sony's new 3-inch disks. Reported problems with quality control on the disks may, however, delay the process. When the unit does appear, it will certainly give both US and other Japanese computer makers a run for their money.

OKI is expanding its US marketing and service network and quietly showed its OKI IF800 at the winter Consumer Electronics Show. The OKI IF800 is now being sold in Japan (for approximately $8000) and is a strong seller for small-business applications.

Toshiba is working on small computers but doesn't seem to be interested in either the US or Japanese



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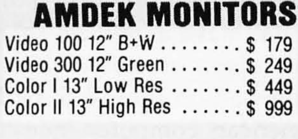


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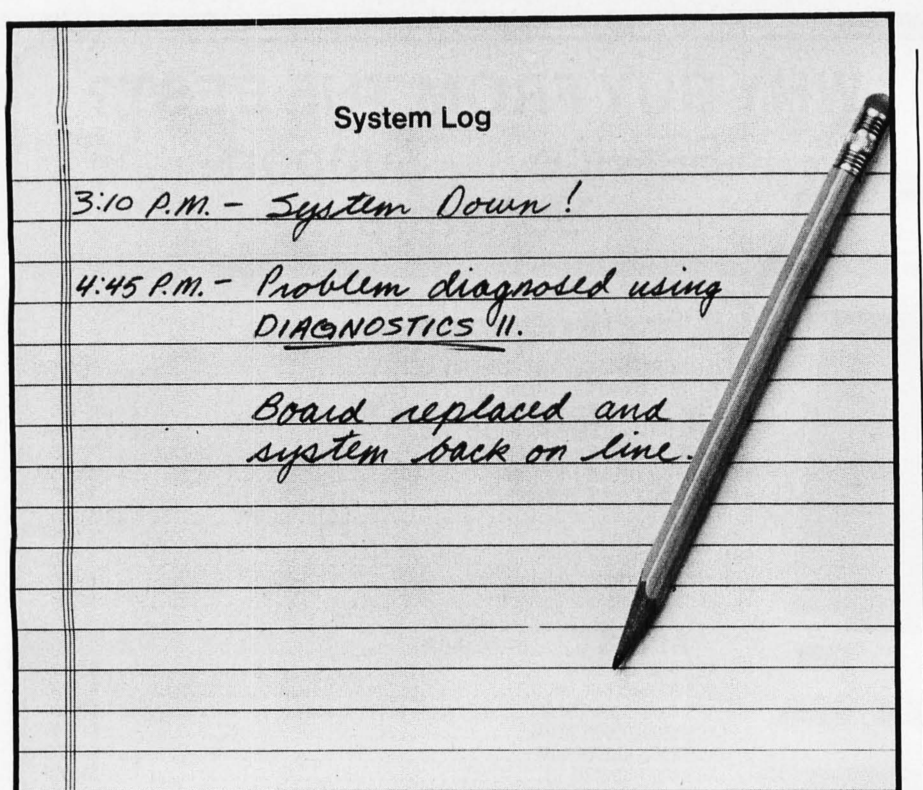
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personal and/or small-business market at this time. The only small computer product it is currently offering is a one-board uncased machine with BASIC and a keyboard that's mainly designed for development work.

AI Electronics Corporation and *Logic Systems International* are two small companies, based in Tokyo, which seem to be quietly working behind the scenes. Both ship about 2000 personal computers a year to Europe—where they are packaged and sold under different names. In the Japanese tradition of secrecy, details on their products are unavailable; however, watch for the names, possibly in conjunction with US companies. Rumors persist that both companies have had major discussions with US companies regarding the marketing of their personal computers in the United States.

Finally, *Sanyo* has exhibited some personal computer prototypes at Japanese trade shows, but seems to have put the project on a back burner for the time being.

Summary

The Japanese personal computers are impressive machines at highly competitive prices. However, the outlook for American computer manufacturers is not entirely grim. There is little if any chance that the influx of Japanese products into our market will have anywhere near the same effect Japanese automobiles and steel have had on those US markets. The American computer industry is far from being the mature and top-heavy group that the auto and steel industries are. The United States developed the computer and that development continues to move forward at a dizzying pace.

In fact, the influx of Japanese personal computers is likely to further spur the domestic computer makers. Their highly experienced marketing and product-development groups are poised to give the Japanese products a run for their money. The bottom line seems to be that the "Japanese Computer Invasion" will result in better products and lower prices for consumers. ■

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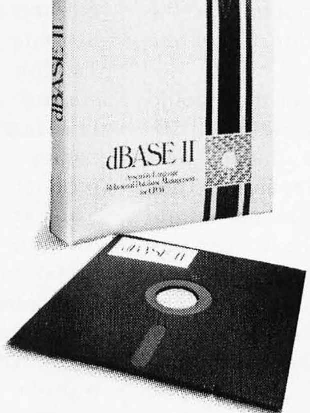
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BYTELINES

News and Speculation About Personal Computing

Conducted by Sol Libes

Small-Computer Confrontation: The battle lines are being drawn between small-computer suppliers and long-established, large-computer companies. Expect the first skirmishes next year. On one side are the microcomputer manufacturers led by Tandy Corporation, Apple Computer Inc, and Commodore Business Machines. On the other, there's IBM, DEC (Digital Equipment Corporation), HP (Hewlett-Packard), Xerox, and Data General. What is at stake is a market estimated at 300,000 units (not including sales to home users) that should exceed $1 billion in sales in 1982.

Here's what's happening: the small-computer makers are introducing larger systems, while the large-computer makers are bringing out smaller systems. The small-computer makers are expanding and strengthening their marketing and distribution channels, while the large, established companies are crowding into the retail area with their own stores and the same outlets that the small-computer makers have been using. Therefore, both groups will soon be competing in the same price/performance areas.

A third factor that should become a significant presence in the market next year is the Japanese. They are expected to concentrate on the small-business market, at this time.

The key to success will be product marketing and distribution, rather than technology—ask IBM. While other manufacturers always seem to have a technological edge, IBM supplies a total marketing program—sales, service, and support.

The Radio Shack division of the Tandy Corporation is expected to hold its own because of its firmly entrenched chain of stores. Presently, Radio Shack has 138 computer stores, 200 company-owned stores, and about 7000 franchises. However, the competition is spreading. Both DEC and IBM have more than two dozen stores in operation. Xerox, with fifteen stores, hopes to have twice that number within the coming year, while HP is expected to open several of its own. HP already sells through independent retailers, and DEC and IBM are expected to go this route along with their own retail outlets.

Status Report: 5-Inch Winchester Disks: Disk manufacturers are rushing into the 5-inch Winchester market with drives providing up to 13 megabytes of storage (unformatted) in the volume of a standard 5-inch floppy-disk drive. The early entrants into the market are Seagate Technology and Tandon Magnetics; both started shipping samples late last year. Other companies with 5-inch hard-disk products in the making are Shugart, Internation Memories, Irwin International, Olivetti, New World Computer, BASF, Computer Memories, and Rotating Memory Systems. Most companies are forwarding samples to OEMs (original equipment manufacturers) and expect to be in limited production by year's end.

Capacities range from 2 to 13 megabytes, unformatted. Prices, per megabyte, range from $90 to $450 in 100-unit quantities (drive only), which compares favorably with 8-inch Winchesters, which currently cost $50 to $400 per megabyte in similar quantities. Although no standard interface has been developed, a number of manufacturers are providing Seagate-compatible interfaces.

Floppy- And Winchester-Drive Capacities Increasing: Iomega, Ogden, Utah, is expected to introduce a 10-megabyte 8-inch floppy-disk drive. It's rumored that Iomega plans to push this up to 100 megabytes. Persi is gearing up to produce a 6.4-megabyte dual 8-inch drive that fits in the same space as a Shugart 850 8-inch drive.

Seagate Technology has a new version of its 5-inch Winchester drive with capacities of 12.76 megabytes unformatted and 10 megabytes formatted. The 3M company has decided to enter the Winchester-drive market after making the media for years. It plans to introduce 10-, 20- and 60-megabyte 8-inch Winchesters.

New 8080/Z80 DOSes: There are three new disk operating systems (DOSes) for Intel's 8080 and Zilog's Z80 microprocessors. MuSys Corporation, Tustin, California, has introduced MuDOS, a CP/M-compatible DOS that provides a management system for handling multiuser access to the disk. MuDOS runs only on Z80-based systems and, MuSys claims, is six times faster than Digital Research's CP/M. The price will be in the $300 to $750 range depending on configuration.

Vortex Technology, Culver City, California, will introduce MARC, a UNIX-like DOS for 8080 and Z80 systems. Designed by Leor Zolman (the creator of the BDS C compiler) and Ed Ziemba, it initially boots under CP/M and has the UNIX-like, tree-structured file system replete with users, groups, protections, and the like. It also has a shell-type command interpreter, shell files (pipes), user-customization modes, and utilities. Vortex expects the system to provide for the transparent running of *most* existing CP/M programs as well as programs written for MARC. Projected price is $175, and for another $75, you can have either the BDS C or the MINCE editor.

InfoSoft, Westport, Connecticut, is introducing MULTI/os for 8080 and Z80 systems. MULTI/os will support up to sixteen users, with a shared data base of 975 megabytes and multiple disk controllers. Like the others, it also maintains CP/M compatibility.

Ada And Little Ada Released: Telesoftware has finally released its Ada com-

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piler. This is the first implementation of Ada on a microcomputer. The first release is for a 16-bit Motorola 68000 machine and provides *most* of the features called for in the Department of Defense Ada standard. Telesoftware hopes to add the missing features in the future. A single-user license is $2000.

For $50, you can obtain a "Little Ada" compiler and interpreter for 8080/Z80-based systems that executes the primary Ada functions. With it, you can get a feel for what Ada is all about. While the compiler is furnished in object-code form, the L-machine run-time interpreter is furnished in source-code form. For more information, contact Ralph Kenyon, 145-103 S Budding Ave, Virginia Beach VA 23452.

TEC To Make TRS-80s In Japan: Tokyo Electric Company (TEC) will manufacture and sell the TRS-80 Model I in Japan through a new agreement with Tandy Corporation. TEC will also market the TRS-80 Models II and III, and the Color units. Tandy stopped the manufacture and sale of the Model I in the US because it did not comply with the FCC (Federal Communications Commission) RF (radio frequency) radiation requirements. TEC is a division of Toshiba, which manufactures its own personal computer.

AT&T And Publishers Clash Over Electronic Information Test: Newspaper publishers in Texas have gone to court to prevent AT&T (American Telephone and Telegraph) from testing its "Electronic Information Service" (EIS). The publishers contend that AT&T is creating a monopoly whereby subscribers would not be properly served. AT&T counters that EIS will be a service from a new company with separate assets. However, the publishers feel that this is a juggling act and a violation of a 1956 Justice Department ruling that stopped AT&T from providing data-processing services of any kind.

The test was to be conducted in Austin, Texas. It was intended to be the prelude to a nationwide information-processing service that would bring yellow-page listings and advertising into the home through television sets.

Software Broadcast Via Radio: Radio Netherlands will experimentally broadcast a short computer program this September tenth. The program will be aired in three different formats (TRS-80, Apple II, and PET). Listeners will be able to record the FM broadcast onto a cassette tape and then play it back into their computer systems. The broadcast will be heard in Australia, Europe, Africa, and North America. For information on frequencies and times, write to Computer Experiment, Media Network, Radio Netherlands, POB 222, 1200 JG Hilversum, Holland.

IEEE-696/S-100 Standard Out Of Committee: After three years, the IEEE (Institute of Electrical and Electronics Engineers) 696/S-100 Bus Standard Committee has submitted a finished standard to the IEEE's computer-standard adoption committee. The standard is now complete and formal adoption is expected early in 1982.

Random News Bits: Sinclair will replace the ZX80 with the ZX81. The ZX81 contains only four integrated circuits in place of the ZX80's twenty-two. The price will drop significantly. . . . Apple Computer has signed a lease for a 160,000-square-foot plant in Carrolton, Texas. Apple plans to add 700,000 square feet of manufacturing space during the next twelve months. Tandy will open a fourth TRS-80 plant in San Antonio, Texas, adding 400,000 square feet of manufacturing space. . . . Zenith reported that its Heath division had sales of $104 million last year. Zenith's total sales were $1.186 billion, with color television sales of $774 million leading the way. . . . Integrated-circuit makers are sharply reducing prices on EEPROMs (electrically erasable, programmable read-only memories). Prices currently average $115 for 1 K by 8-bit devices and $67 for the 512 by 8-bit variety, in 100-unit lots. The parts boast a 500 ns access time and 10-year data retention. . . . Intel's profits for the first quarter of 1981 were down 91.3%. The decline is attributed to the falling price of memory devices. As a result, Intel plans to cut capital spending by $30 million. . . . Pick & Associates, developer of the Microdata Disk Operating System, is working with Intel on the disk operating system for the 32-bit iAPX-432 microprocessor. It's currently running on Hewlett-Packard, ADDS, Honeywell, ECSC, and Microdata minicomputer systems. Pick is also working on a Motorola 68000 implementation. . . . Intel has reduced the price of the 8085 microprocessor to $4 in large quantities and to under $5 in 100-unit lots. Intel wants to compete with other suppliers of the same part (NEC, Toshiba, Mitsubishi, and Siemens) and outrun competition from Zilog's Z80 microprocessor.

Random Rumors: IBM is rumored readying two under-$1000 personal-computer systems at its Raleigh, North Carolina, facility. One system attaches to the telephone line and serves as a home-information system (bank-at-home, teleshopping, etc). The other is a very-small-business system aimed at the professional market (lawyers, doctors, etc). Neither system will be as versatile as a stand-alone product because IBM does not want to hurt its regular systems sales. Also, IBM is said to be developing an under-$5000 small-business system aimed at competing with the Apple II, TRS-80, and PET. . . . DEC reportedly has working prototypes of its Tiny-11, which blends into one integrated circuit the current four-device set of the LSI-11/2. Industry pundits say it works with standard memory and I/O (input/output) devices. . . . Zilog is rumored developing a 32-bit microprocessor for introduction by mid or late 1982. . . . Later this year, you can expect a removable 1-megabyte bubble-memory cassette from Intel. Fujitsu introduced 8 K- and 32 K-byte bubble cassettes last year. Plan on National Semiconductor to introduce an 8 K-byte bubble cassette and cassette unit with controller in the $2000 to $3000 range. . . . **Rumors from all over:** Expect an under-$2000 small-business computer from Sony to include a Z80, 64 K bytes of programmable memory, video display, 1.2 megabytes of floppy-disk storage, and a printer port. . . . Vector Graphic,

R&D COMPUTER SYSTEMS

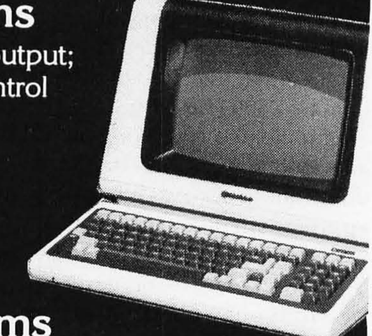
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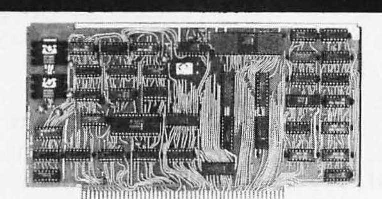
8086 16 Bit Micro Systems

31 MByte Winchester Drives
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8086 Software

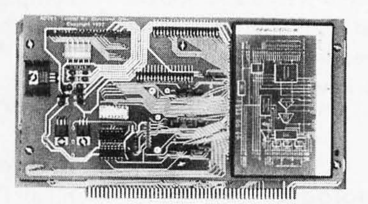


Real Time Video Digitization Systems

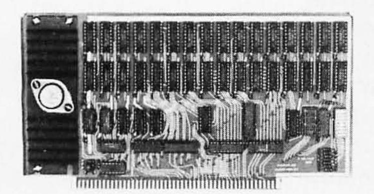
S-100 Boards



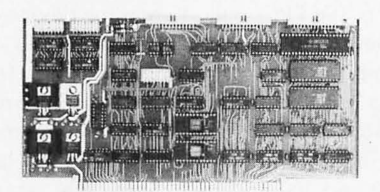
8086 CPU with Vectored Interrupts



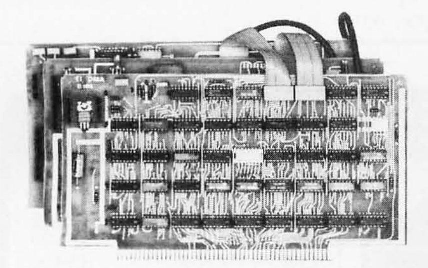
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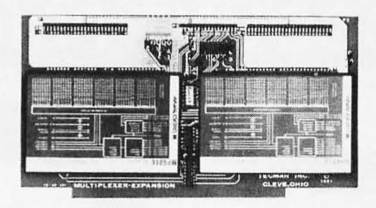
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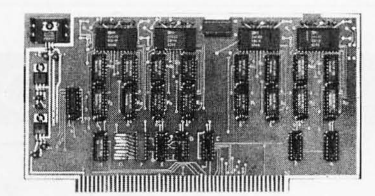
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2 RS 232 - PIO
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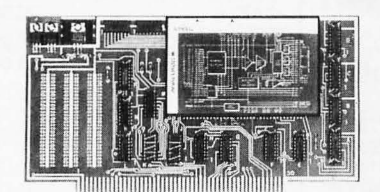
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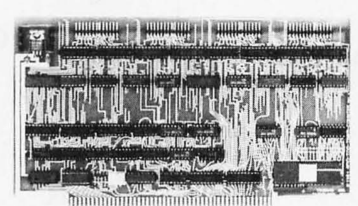
Expansion Multiplexer



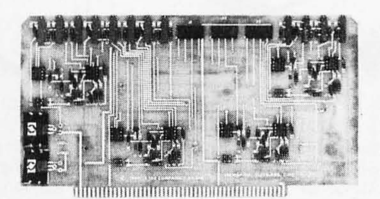
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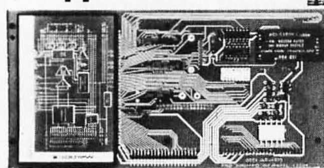


4 PIO and Timer/Counter



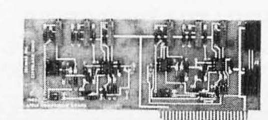
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boasting sales in the $30 million range, will go public with a stock offering this summer. It is also developing a Z8000-based system. . . . Cromemco is working on an IBM-compatible tape-drive unit to serve as a backup for hard disks. It's also working on a 68000-based S-100 microprocessor card. . . . Godbout Electronics, which recently introduced a 128 K-byte S-100 programmable memory card, is now ready to unveil a 256 K-byte version. . . . Sperry Univac may be the first customer for Intel's new 32-bit microprocessor. . . .

Apology: I must apologize to MicroDaSys, Los Angeles, California. In the March 1981 "BYTELINES" (see page 242), I gave credit to another company for having the first 16-bit system using the new Motorola 68000 microprocessor. MicroDaSys was actually first, advertising its 68000 system in the September 1980 BYTE.

The MicroDaSys "68 K MiniFrame" contains a 68000, 6809 memory manager (for true virtual-memory operation), 512 K bytes or 2 megabytes of programmable memory, disk controller, memory parity, and ten I/O ports. The system operates at 8 MHz and, the company claims, is faster than the DEC PDP-11/45.

Personal Computer With 768 K Bytes Of Memory: Southwest Technical Products (SwTPC) will release a new 6809-based personal computer that can address up to 768 K bytes of memory. Also slated to be introduced are hard-disk systems of 32 and 300 megabytes that are chainable—the maximum number has not been determined. Lastly, SwTPC will market a 32-terminal I/O (input/output) board for the system. The system will run the TSC (Technical Systems Consultants) Uniflex operating system supporting 32 users.

SwTPC has come a long way from its first personal computer, which had 4 K bytes of memory, audio-cassette storage, and a 2 K-byte BASIC interpreter.

Intel Seeks Injunction: Intel is seeking an injunction against Seeq Inc, Milipitas, California. The suit seeks to temporarily bar Seeq from making devices similar to Intel's 2864, a 64 K-bit EEPROM (electrically erasable, programmable read-only memory) that may be marketed later this year. Seeq was started by four former Intel staffers who had worked in Intel's special-products division while the 2864 was being developed. Seeq intends to develop nonvolatile memory devices.

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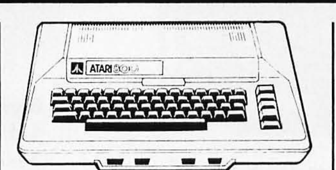
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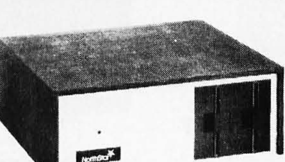


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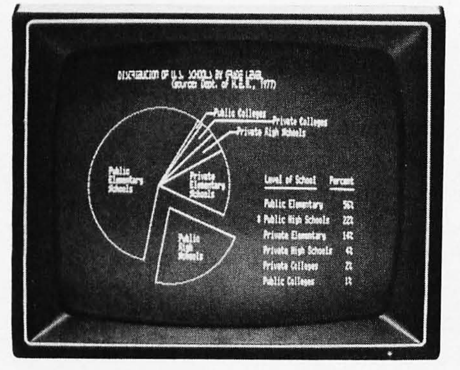
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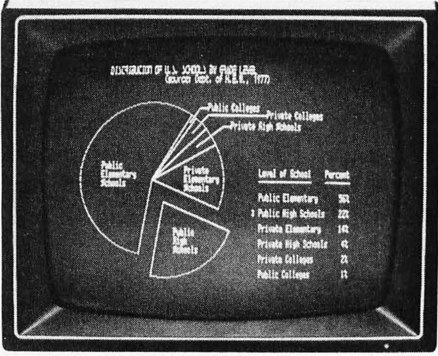
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Building Data Structures in the Smalltalk-80 System

James C Althoff Jr
Learning Research Group
Xerox Palo Alto Research Center
3333 Coyote Hill Rd
Palo Alto CA 94304

Most programmers are exposed to the concept of data structures very early in their programming experience. A course in data structures is an integral part of most computer science curricula, and there are many excellent and widely used texts on the subject (see references 1, 2, and 4). The data structures covered in these texts generally include the linear list, stack, queue, tree, and graph.

In this article, we will define and implement some of the simplest structures, including the linear list, stack, and queue. Our approach will be to describe each data structure informally, and then to show a Smalltalk-80 class definition that closely matches this informal description. We will see that it is possible, using the class construct, to create programming structures that clearly mirror the entities being implemented. However, in order to demonstrate how to build these data structures from scratch, we will not make use of any of the advanced data structure classes that already exist in the Smalltalk-80 system.

We will make extensive use of the Smalltalk-80 subclass mechanism in the class definitions we introduce. We will use subclassing to facilitate the construction of different implementations of the same entity. In addition, we will see how the subclass mechanism enables us to define two or more related classes in such a way that the common parts of their definition can be shared.

Notation

In order to understand the program examples presented in this article, the reader should have some familiarity with the Smalltalk-80 programming language. For an introduction to the language and a fuller discussion of subclasses, see "The Smalltalk-80 System," on page 36. In addition, a text box on page 240 of this article contains a brief description of some of the messages that we will use in the examples.

The advantage of the sequential list is that it is easy to access and replace an arbitrary item in the list.

For each data structure that we describe, we will give a corresponding Smalltalk-80 class definition. Each class definition will be presented in the form of a template that shows the instance variables, messages, and other information associated with the class. (A complete description of the template can be found in the article mentioned above.)

The messages defined in the template are partitioned into two main groups. The first comprises the class messages. These are messages that are sent to the class itself (which is, in actuality, an object). For our purposes, these will be a set of creation messages that can be sent to the class in order to create a new, initialized instance of the class. The second group consists of a set of messages that can be sent to instances of the class. These will be divided into two more groups. The first is a collection of external messages that represent the interface between an instance of the class and clients (ie: other objects in the system) of that instance. The second is a set of internal messages used in methods that are defined in the class or a subclass but are not intended for wider use. Note that the distinction between internal and external messages is made for conceptual clarity. The Smalltalk-80 programming language does not have a mechanism for controlling message usage.

An example of a class definition is given in table 1. This template defines a class whose name is Card. An instance of class Card can be used to represent a card in a game program. Class Card has instance variables named suit, rank, and faceUp. A new instance is created by sending class Card the creation message suit:rank:. For example:

```
|aCard|
aCard ← Card suit: 'heart' rank: 7.
```

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creates a new instance of Card that represents the seven of hearts. In the method for suit:rank:, the message new creates an uninitialized instance. The internal message setSuit:setRank: sets the suit and rank fields and initializes the new instance to be "face down." Given an instance of class Card, we can determine its suit, rank, and orientation, and change the latter using the external messages specified in the class definition. Because we do not want to be able to change the suit and rank of an instance once it has been created, we do not include a message for doing this operation in the set of external messages.

The methods shown here demonstrate a convention we will use in subsequent examples. All of the names that we use for parameters and local variables will be formed by taking the name of a class and preceding it with an indefinite article. For example, the two parameters to the message setSuit:setRank: are named aString and anInteger. Such a name indicates what kind of object is expected as the value of the parameter or local variable to which the name refers. Smalltalk-80 has no type-checking; this is only a convention to help make the examples more understandable.

We will now examine a number of elementary data structures and their implementation with Smalltalk-80 classes. In the informal description of each data structure, we will include a list of operations that are meaningful for that structure. We will then show a corresponding class definition whose external messages match the listed operations. The details of the implementation of the data structure will be hidden in the class definition. We will see how this process enables us to define different classes that reflect different implementations of the same basic data structure.

The Linear List

The first data structure we will examine is the *linear list*. A linear list is a sequence of data items that have, essentially, a one-dimensional relationship to one another (see figure 1). That is to say, given an object in the sequence, we can find the object that precedes or follows it. For example, if we have a program that deals with a game of cards, we might represent

class name	Card
superclass	Object
instance variable names	suit rank faceUp
class messages and methods	

```
sult: aString rank: anInteger | aCard |
   aCard ← self new. aCard setSuit: aString setRank: anInteger.
   ↑ aCard.
```

instance messages and methods

```
external
sult | | ↑ suit.
rank | | ↑ rank.
turnFaceUp | | faceUp ← true.
turnFaceDown | | faceUp ← false.
turnOver | | faceUp ← faceUp not.
isFaceUp | | ↑ faceUp.
isFaceDown | | ↑ faceUp not.

internal
setSult: aString setRank: anInteger | |
   suit ← aString. rank ← anInteger. self turnFaceDown.
```

Table 1: *Class template for class* Card.

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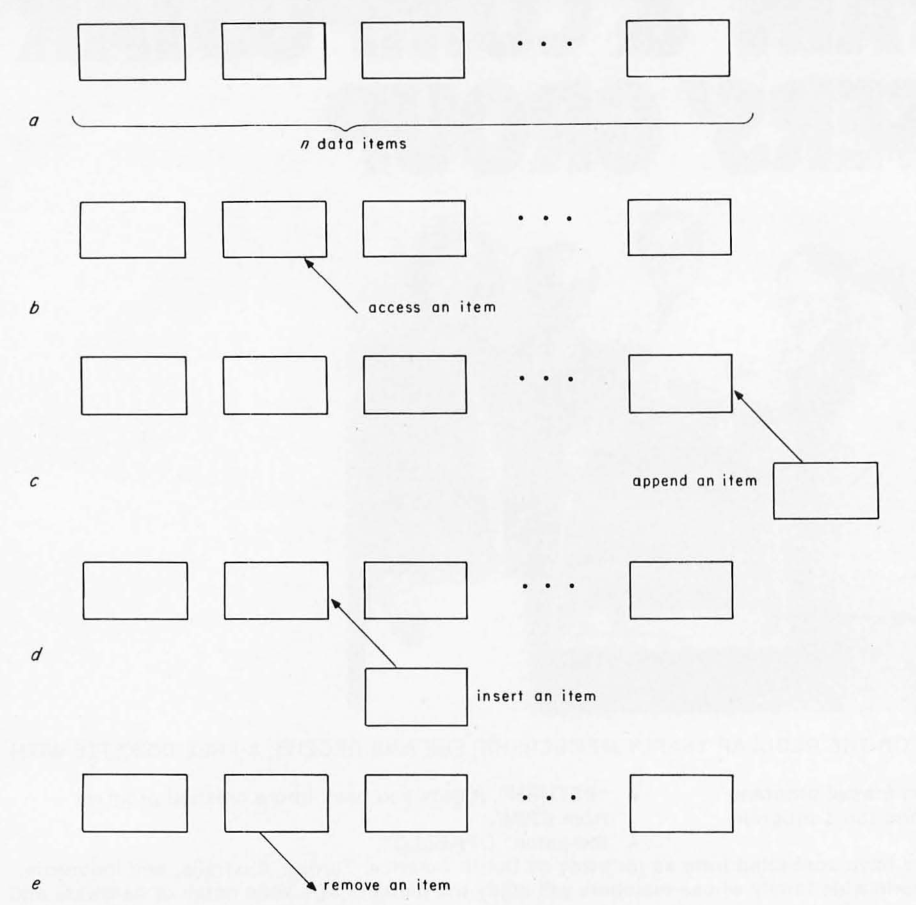


Figure 1: *A linear list (1a) is a collection of objects arranged in linear sequence. Permissible operations include accessing (1b), appending (1c), inserting (1d), and removing an item (1e).*

each card hand as a linear list of cards.

The operations that we might want to perform on a linear list include:

- determine how many items are in the list
- determine whether or not the list is empty
- access the *i*th item in the list
- append an item to the end of the list
- insert an item at some position in the list
- replace an item at some position in the list with some other item
- remove an item from the list

In order to implement a linear list of data items, we need to implement both the data items and the linear list. In all of our subsequent examples, we will assume that we have implemented the data items with one or more class definitions (eg: class Card). When we are describing things in general, we will use such terms as "data item" and "linear list." When we are describing a specific implementation, we will refer instead to the "object" (or "instance of a class") that represents the entity under consideration.

Linear lists are partly defined in the template given in table 2. Class LinearList, as defined in table 2, is incomplete since there is no mechanism for actually storing objects that represent data items. This is because there are several different strategies for storing these objects in a linear list. For each strategy, we will define a different class, each of which is a subclass of LinearList. All of these classes have some characteristics in common; these are captured in the superclass LinearList. For example, because all of the subclasses that we

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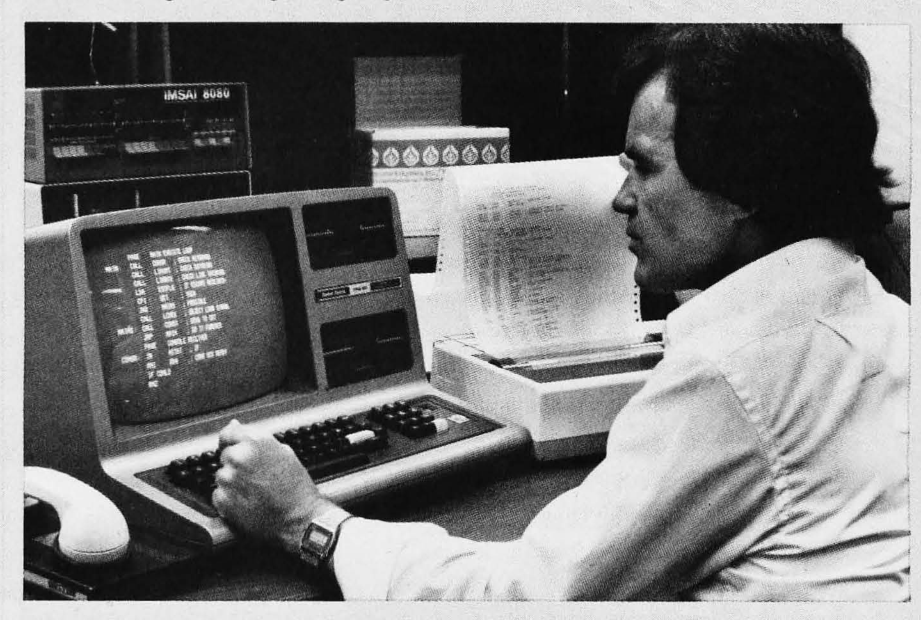
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class name	LinearList
superclass	Object
instance variable names	count
class messages and methods	

"none defined here"

instance messages and methods

```
external
count | | ↑ count.
empty | | ↑ count = 0.
"at: anInteger | | ... to be defined in subclasses"
"append: anObject | | ... to be defined in subclasses"
"insert: anObject at: anInteger | | ... to be defined in subclasses"
"replace: anObject at: anInteger | | ... to be defined in subclasses"
"removeAt: anInteger | | ... to be defined in subclasses"

internal
initialize | | count ← 0.
checkIndex: anInteger | |
    (anInteger < 1) | (anInteger > count)
    ifTrue: [ ↑ self error: 'index out of range' ].
```

Table 2: *Class template for class* LinearList.



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will define keep count of the number of objects (representing data items) in the list, a corresponding instance variable, count, is defined in the superclass LinearList. Similarly, all subclasses can make use of an internal message, initialize, that initializes count to zero, and another message, checkIndex:, that insures that any index specified as a parameter to one of the access messages (at:, insert:at:, and so on) is within range. Since we start the numbering of items in a linear list at 1, the range will always be between 1 and count (the number of items in the list). Also, the message empty is implemented in the superclass since the answer to whether or not the list is empty can be determined from the value of count.

The Indexed Table

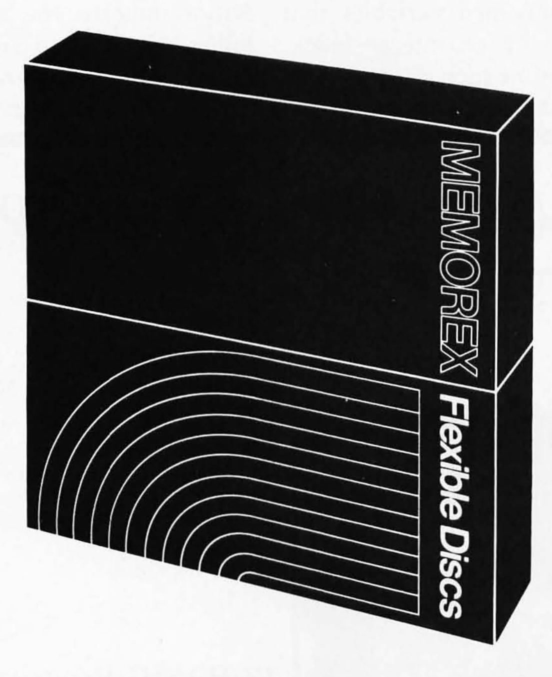
The first strategy we will explore for actually storing data items in a linear list involves the sequential allocation of storage. In order to see how this works, we will interrupt our discussion of the linear list and introduce a very basic data structure that we will call an *indexed table* (see figure 2). An indexed table, *which* corresponds to what is called a one-dimensional array in many programming languages, is a relatively simple structure that closely matches the physical memory of most computers. As we will see, many useful data structures, including the linear list, can be implemented with an indexed table.

An indexed table comprises a sequence of variables into which we can store and from which we can retrieve data items. Each variable is designated by an integer. The smallest integer used to designate a variable in an indexed table is called the *lower bound* of the table. The largest integer is called the *upper bound*. The operations that we wish to perform on an indexed table are:

- specify the lower and upper bounds of the table (when it is created)
- determine the lower and upper bounds of the table
- determine the number of variables allocated to the table

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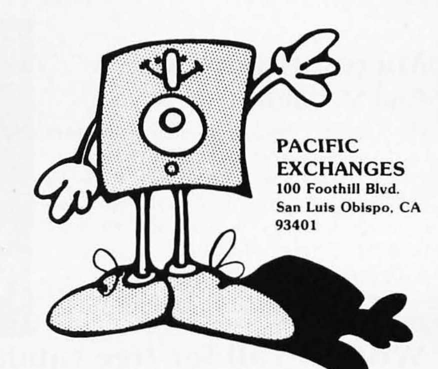


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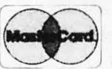
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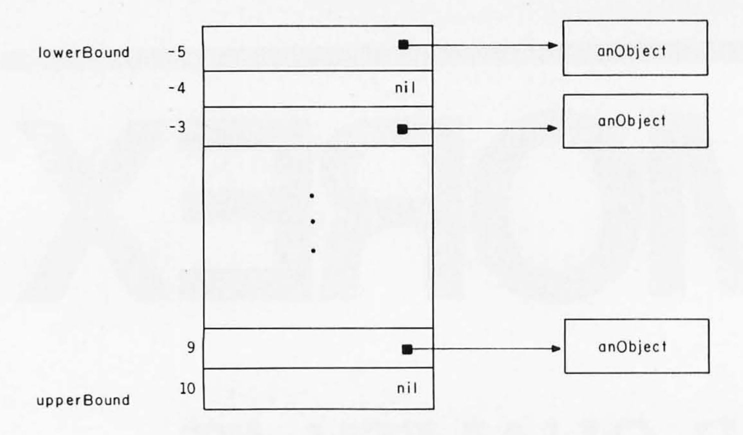


Figure 2: *An indexed table.*

- access an item at a particular position in the table
- put an item at a particular position in the table

In order to store into an indexed table, we specify an item to be stored and an integer that indicates the particular variable that will contain the item. In order to retrieve from an indexed table, we need only specify which variable of the table has the data item of interest.

The class definition in table 3 shows how to implement an indexed table. We have seen in the definition of classes Card and LinearList how to specify a fixed number of named instance variables in a class definition. What we need in order to implement an indexed table, however, is a sequence of unnamed variables that are designated by an integer index. How can we define such a sequence of variables? We do this by specifying the number of indexed variables needed for an instance at the time that an instance of a class is created. The creation message from:to: in class IndexedTable sends the message new:, whose parameter is the number of indexed variables required for the instance being created. In order to access these variables, we send low-level (ie: primitive) access messages with a parameter that specifies an appropriate index (starting at 1). The access message basicAt: i retrieves the object stored in the *i*th indexed instance variable. The access message basicAt: i put: anObject stores a pointer to anObject in the *i*th indexed instance variable.

In addition to indexed instance variables, class IndexedTable has two named instance variables: lowerBound and upperBound. lowerBound is an integer that indicates the smallest allowable index for a particular instance of IndexedTable; upperBound indicates the largest allowable index. In order to create a new indexed table, we send the message

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class name	IndexedTable
superclass	Object
instance variable names	lowerBound upperBound
class messages and methods	

```
from: anInteger1 to: anInteger2 | |
    (anInteger1 > anInteger2) ifTrue: [ ↑ self error: 'invalid bounds' ].
    ↑ (self new: anInteger2 − anInteger1 + 1)
    lowerBound: anInteger1 upperBound: anInteger 2.
```

instance messages and methods

```
external
lowerBound | | ↑ lowerBound.
upperBound | | ↑ upperBound.
size | | ↑ upperBound − lowerBound + 1.
at: anInteger | |
    self checkIndex: anInteger.
    ↑ self basicAt: (anInteger − lowerBound + 1).
put: anObject at: anInteger | |
    self checkIndex: anInteger.
    self basicAt: (anInteger − lowerBound + 1) put: anObject.

internal
lowerBound: anInteger1 upperBound: anInteger2 | |
    lowerBound ← anInteger1. upperBound ← anInteger2.
checkIndex: anInteger | |
    (anInteger < lowerBound) | (anInteger > upperBound)
    ifTrue: [ ↑ self error: 'index out of range' ].
"basicAt: i | | ... this is a primitive Smalltalk-80 message that accesses the ith indexed
  instance variable."
"basicAt: i put: anObject | | ... this is a primitive Smalltalk-80 message that stores a pointer
  to anObject in the ith indexed instance variable."
```

Table 3: *Class template for class* IndexedTable.

Some Smalltalk Messages

The following messages are used in this article without having been previously defined. Each is either provided by the Smalltalk-80 system, or easily implemented using other messages provided by the system. For each message, we provide a brief, informal description of its intended effect.

new—*Creates a new instance.*
new: i—*Creates a new instance with* i *indexed instance variables.*
error: aString—*Causes some appropriate action to occur, such as interrupting program execution and displaying* aString.
not—*The "logical not" operation.*
| —*The "logical or" operation.*
+, −, *, /, =, <, >, <=—*Arithmetic operations and relations.*

Flow of control is affected by sending messages that correspond to basic control structures. For example:

a ifTrue: [b] *corresponds to:* if a then b end
a ifTrue: [b] ifFalse: [c] *corresponds to:* if a then b else c end
x to: y do: [: i | a] *corresponds to:* for i from x to y by 1 repeat a end
x downTo: y do: [: i | a] *corresponds to:* for i from x to y by −1 repeat a end
x timesRepeat: [a] *corresponds to:* repeat x times a end

from:to: to class IndexedTable. For example:

```
| table |
table ← IndexedTable from: −5 to:
  10.
```

creates a new instance of IndexedTable whose indices range from −5 to 10. This message is implemented using an internal message, lowerBound:upperBound:, that sets the instance variables of a newly created instance to their appropriate values.

Once we have created an instance of IndexedTable, we can perform the operations specified in the above description of indexed tables by sending the messages lowerBound, upperBound, size, at:, and put:at:. lowerBound and upperBound return the corresponding values of the instance variables; size computes and returns the number of indexed instance variables in the table. at: and put:at: both use an internal message, checkIndex:, in order to make sure that their index parameter is within range of the lower and upper bounds of the table. at: returns the object stored in the indexed instance variable indicated by the integer parameter; put:at: stores the object, specified as the first parameter, in the indexed instance variable indicated by the second parameter. Notice that both at: and put:at: use the value of lowerBound to map indices from the range of the table to the range of the indexed instance variables that are used to implement the table.

As an example of how we might use class IndexedTable, consider the following sequence of messages:

```
| table |
table ← IndexedTable from: 1 to:
  13.
1 to: 13 do: [: i | table put: (Card
  suit: 'heart' rank: i) at: i. ].
```

This creates a new instance of class IndexedTable with indices that range from 1 to 13 and fills it with instances of class Card whose ranks match the indices.

The Sequential List

Now that we have an implementa-

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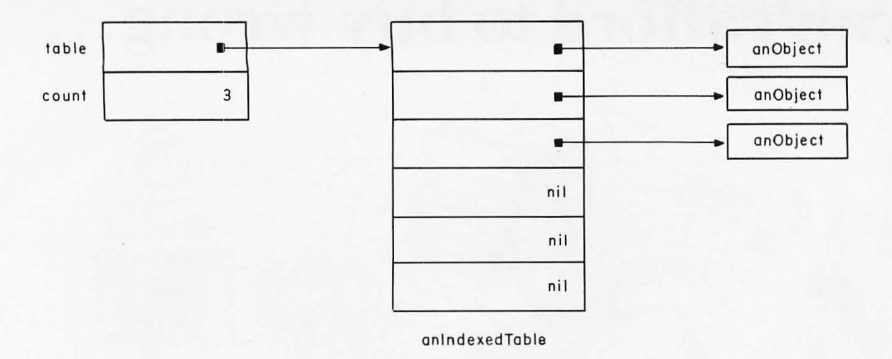


Figure 3: *A sequential list.*

tion for indexed tables, we can use them to demonstrate our first implementation of linear lists. We will call a linear list that uses an indexed table to store its data items a *sequential list* (see figure 3). The basic idea is to manage an indexed table so that the first *i* consecutive entries in the table are the *i* data items in our linear list. The most difficult operations using this strategy are the insertion and removal of items, since these cause parts of the indexed table to be copied from one area to another. An additional difficulty is that we must specify, at the time we create the linear list, the expected maximum number of items in the list. This is necessary because indexed tables come in fixed sizes, which means that if the list grows larger than this initial number, we must do something to accommodate the extra items. (Details are shown in the class definition given in table 4.)

The creation message size: is used to create an instance of SequentialList of some estimated maximum size. For example:

```
| list |
list ← SequentialList size: 5.
```

creates a list with enough space, initially, for five objects. The internal message initialize:, which is sent from size:, creates an instance of IndexedTable of the appropriate size and assigns it as the value of the instance variable named table. The other internal message, expand, is used to enlarge table when it becomes full. This is done by creating a new instance of IndexedTable that is twice as large as the original and by copying the objects from the original table into the first half of the new table. The new table is then assigned as the value of table for subsequent use.

Retrieval from SequentialList is done by retrieving from its associated indexed table. A new object can be appended to the list by storing it in the next available location of the indexed table of that list. This location is determined by the value of count. If there is still room in the table, count is incremented and the object is stored. Otherwise, the sequential list has to be expanded, which is accomplished using the message expand, described previously. Insertion into the list is done by copying from their current location to the next, all objects after, and including, the one at the desired location. A new object can then be stored at that location. Removing an object from a list is done analogously. An object is replaced by storing another object in the corresponding position in the indexed table.

The advantage of the sequential list is that it is easy to access and replace (not remove) an arbitrary item. The disadvantages are that it is necessary both to estimate the maximum size of the list when it is created (although, as we have seen, the list can expand when necessary) and to move items around when inserting or removing them from the list.

Let us now consider an example that shows how to create and send messages to an instance of class SequentialList. Suppose we want to represent a deck of cards and two hands, dealt from the deck. To create

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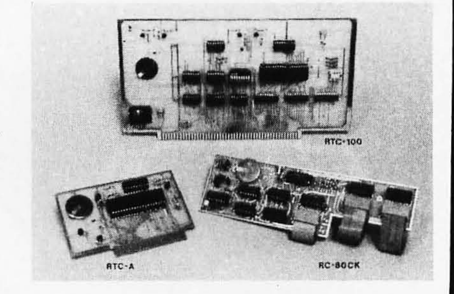
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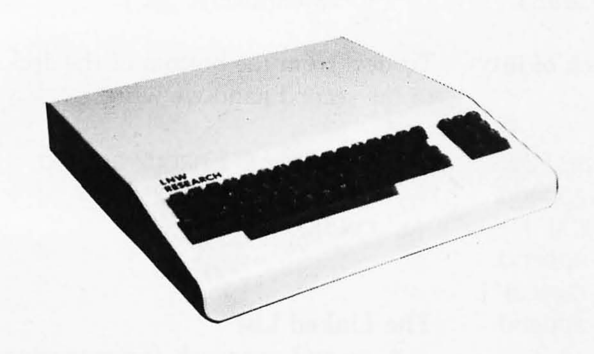
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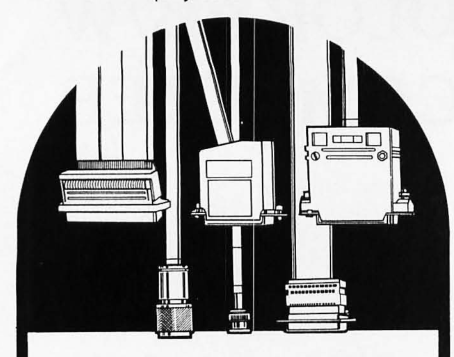
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two initially empty hands we write:

```
| hand1 hand2 deck |
hand1 ← SequentialList size: 5.
hand2 ← SequentialList size: 5.
```

To create an unshuffled deck of fifty-two cards we write:

```
deck ← SequentialList size: 52.
1 to: 13 do: [: i | deck append:
  (Card suit: 'heart' rank: i). ].
1 to: 13 do: [: i | deck append:
  (Card suit: 'diamond' rank: i). ].
1 to: 13 do: [: i | deck append:
  (Card suit: 'club' rank: i). ].
1 to: 13 do: [: i | deck append:
  (Card suit: 'spade' rank: i). ].
```

Then, to deal five cards from the deck to the first hand we write:

```
5 timesRepeat: [ hand1 append:
  (deck removeAt: 1). ].
```

To deal from the bottom of the deck to the second hand we write:

```
5 timesRepeat: [ hand2 append:
  (deck removeAt: deck
  count). ].
```

The Linked List

A second approach for managing the storage of items in a linear list is to use a *linked list*. The strategy for

class name	SequentialList
superclass	LinearList
instance variable names	table
class messages and methods	

```
size: anInteger | |
  (anInteger > 0) ifTrue:  [ ↑ (self new) initialize: anInteger ]
                  ifFalse: [ ↑ self error: 'invalid size' ].
```

instance messages and methods

```
external
at: anInteger | | self checkIndex: anInteger. ↑ table at: anInteger.
append: anObject | |
  (count = table size) ifTrue: [ self expand. ].
  table put: anObject at: count + 1.
  count ← count + 1.
insert: anObject at: anInteger | |
  self checkIndex: anInteger.
  (count = table size) ifTrue: [ self expand. ].
  count downTo: anInteger do: [: i | table put: (table at: i) at: i + 1. ].
  table put: anObject at: anInteger.
  count ← count + 1.
replace: anObject at: anInteger | |
  self checkIndex: anInteger.
  table put: anObject at: anInteger.
removeAt: anInteger | anObject |
  anObject ← self at: anInteger.
  anInteger + 1 to: count do: [: i | table put: (table at: i) at: i − 1. ].
  count ← count − 1.
  ↑ anObject.

internal
initialize: anInteger | |
  super initialize.
  table ← IndexedTable from: 1 to: anInteger.
expand | anIndexedTable |
  anIndexedTable ← IndexedTable from: 1 to: 2 * count.
  1 to: count do: [: i | anIndexedTable put: (table at: i) at: i. ].
  table ← anIndexedTable.
```

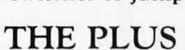
Table 4: *Class template for class* SequentialList.

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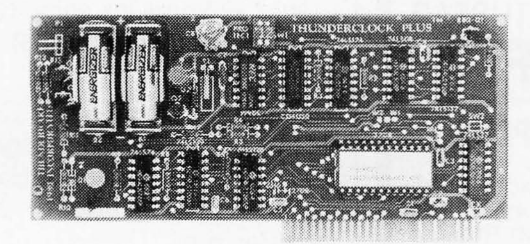
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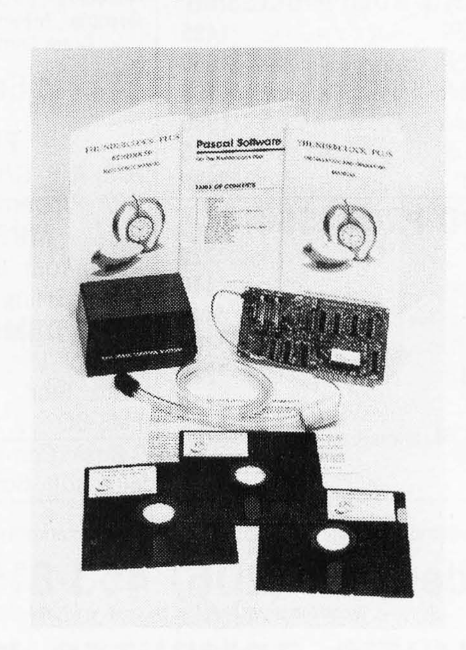
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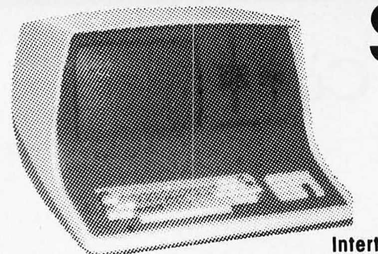
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using a linked list is the following: instead of allocating sequentially the storage needed to hold data items, we allocate separate storage objects, called *links*, each of which keeps track of a data item and either one or two other links. A set of links are connected together to form a linked list. A *single link* (see figure 4a) is one that keeps track of a data item and one other link, which is its successor. A *double link* (see figure 4b) has a data item and two other links: its successor and its predecessor.

Class SingleLink is defined as shown in table 5. It has instance variables named entry and successor; entry points to an object that represents a data item, successor points either to another instance of class SingleLink, or, if there is no successor, to the object nil. We specify the entry and successor of a single link at the time we create it. For example:

```
| link1 link2 |
link1 ← SingleLink entry: (Card
    suit: 'club' rank: 4) successor:
    nil.
link2 ← SingleLink entry: (Card
    suit: 'diamond' rank: 6)
    successor: link1.
```

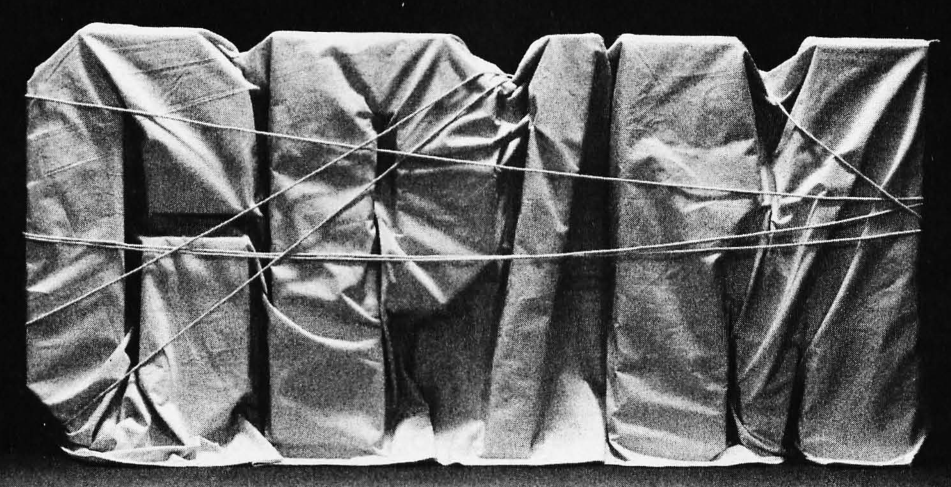
creates two links. The entry of the first link is an instance of class Card that represents the four of clubs. Its successor is nil. The entry of the second link is an instance of class Card that represents the six of diamonds; its successor is the first link.

The class definition for double links is given in table 6. Class DoubleLink inherits from class SingleLink the instance variables and messages that are used to implement the entry and successor of a double link. In addition, there is an instance variable named predecessor that points either to an instance of class DoubleLink or to nil. The messages predecessor: and predecessor set and return, respectively, the value of predecessor.

As stated previously, a linked list is a sequence of links connected in a linear arrangement. We can make different kinds of linked lists depending on the links we use and the precise

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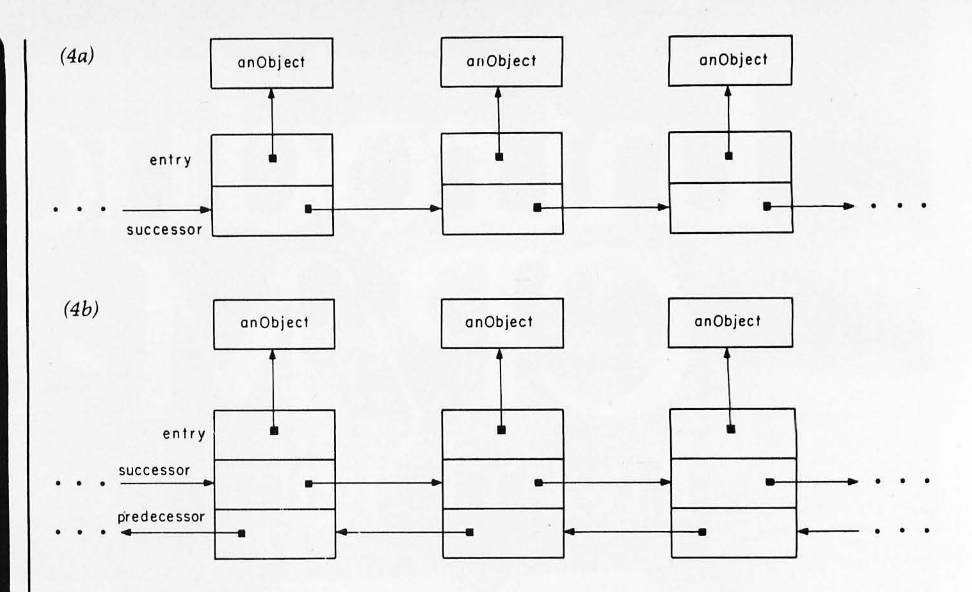


Figure 4: *Two kinds of links. Figure 4a shows a list of storage objects joined by single links, while figure 4b shows a similar list joined by double links.*

class name	SingleLink
superclass	Object
instance variable names	entry successor
class messages and methods	

entry: anObject successor: aSingleLink | |
↑ ((self new) entry: anObject) successor: aSingleLink.

instance messages and methods	

external
entry | | ↑ entry.
entry: anObject | | entry ← anObject.
successor | | ↑ successor.
successor: aSingleLink | | successor ← aSingleLink.

internal
"none defined here"

Table 5: *Class template for class* SingleLink.

way that they are connected together. Table 7 defines class LinkedList, which acts as the superclass of the various linked lists we will consider. It collects several messages that are suitable for all of the LinkedList subclasses.

The message linkAt: is used internally by LinkedList methods. Taking an integer as a parameter, it traverses a sequence of connected links looking for the link in the position indicated by that integer. It returns this link as a result. This message is not intended for use outside of the class since we don't want the rest of the system to have access to the internal structure of the list. The messages at: and replace:at: can be defined using linkAt: since, once the appropriate link is found, it is easy to return or replace its corresponding entry.

The Singly Linked List

The first type of linked list we will examine is the *singly linked list*. A singly linked list is a sequence of single links connected together so that the successor of the first link is the second link, the successor of the second



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link is the third link, and so on (see figure 5). The successor of the last link is nil.

The definition for class SinglyLinkedList is given in table 8. Class SinglyLinkedList has an instance variable named firstLink that points either to the first object in the list or to nil if the list is empty. The internal message initialize, which is sent when an instance of SinglyLinkedList is created, sets firstLink to nil. The internal message firstLink, which is never sent to an empty list, returns the SingleLink instance pointed to by firstLink.

In the implementation of the message append:, we first create a new link whose entry is the object passed as a parameter. We then check

class name	DoubleLink
superclass	SingleLink
instance variable names	predecessor
class messages and methods	

```
entry: anObject successor: aDoubleLink1 predecessor:
  aDoubleLink2 | |
   ↑ (self entry: anObject successor: aDoubleLink1) predecessor:
     aDoubleLink2.
```

instance messages and methods

```
external
predecessor | | ↑ predecessor.
predecessor: aDoubleLink | | predecessor ← aDoubleLink.

internal
"none defined here"
```

Table 6: *Class template for class* DoubleLink.

class name	LinkedList
superclass	LinearList
instance variable names	"none defined here"
class messages and methods	

```
new | | ↑ (super new) initialize.
```

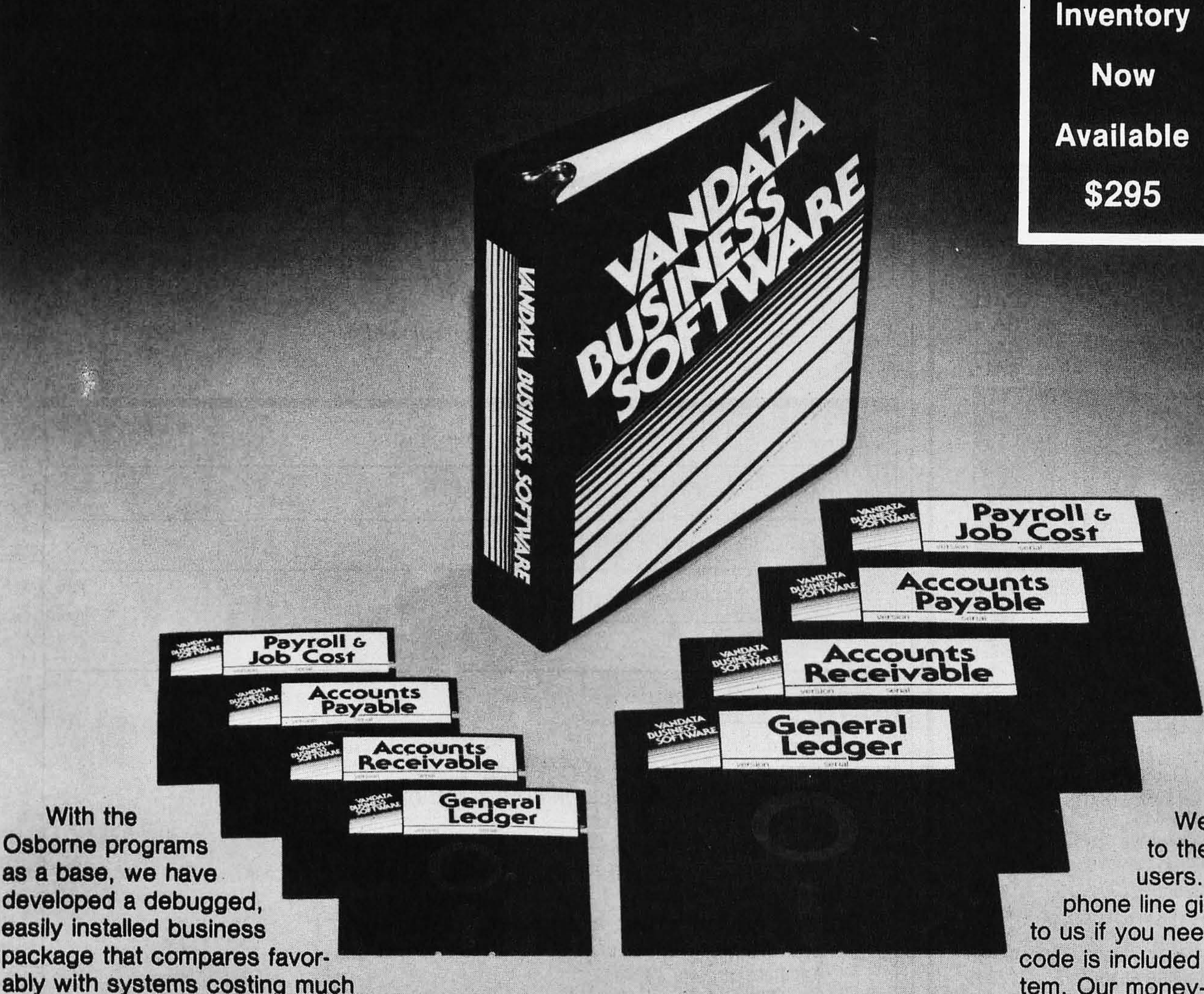
instance messages and methods

```
external
at: anInteger | |
    self checkIndex: anInteger.
    ↑ (self linkAt: anInteger) entry.
replace: anObject at: anInteger | |
    self checkIndex: anInteger.
    (self linkAt: anInteger) entry: anObject.

internal
"firstLink | | ... to be defined in subclasses"
linkAt: anInteger | aLink |
    aLink ← self firstLink.
    (anInteger − 1) timesRepeat: [ aLink ← aLink successor. ].
    ↑ aLink.
```

Table 7: *Class template for class* LinkedList.

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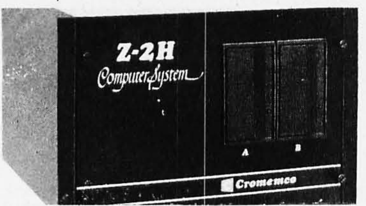
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to see if the list is empty, and if so we set firstLink to point to the new link. If the list is not empty, we get the last link in the list and make its successor the new link. In either case, we increment the value of count to keep track of the new number of objects in the list.

In general, to insert a data item into a singly linked list, we create a new link for the item and then find the link that the new link is to follow. We then make this link point to the new link, and have the new link point to the former successor of this link (see figure 6a). The only exception to this process occurs if we are adding the data item to the beginning of the list. In this case there is no predecessor, so we simply point the new link to the

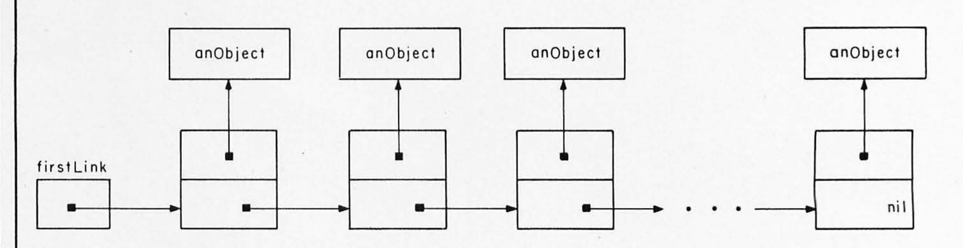


Figure 5: *A singly linked list.*

class name	SinglyLinkedList
superclass	LinkedList
instance variable names	firstLink
class messages and methods	
"none defined here"	
instance messages and methods	

```
external
append: anObject | aSingleLink |
   aSingleLink ← SingleLink entry: anObject successor: nil.
   self empty
      ifTrue: [ firstLink ← aSingleLink. ]
      ifFalse: [ (self linkAt: count) successor: aSingleLink. ].
   count ← count + 1.
insert: anObject at: anInteger | aSingleLink |
   self checkIndex: anInteger.
   (anInteger = 1)
      ifTrue: [ firstLink ← SingleLink entry: anObject successor: firstLink. ]
      ifFalse: [ aSingleLink ← self linkAt: anInteger − 1.
         aSingleLink successor: (SingleLink entry: anObject successor:
         aSingleLink successor). ].
   count ← count + 1.
removeAt: anInteger | aSingleLink anObject |
   self checkIndex: anInteger.
   (anInteger = 1)
      ifTrue: [ anObject ← firstLink entry. firstLink ← firstLink successor. ]
      ifFalse: [ aSingleLink ← self linkAt: anInteger − 1.
         anObject ← aSingleLink successor entry.
         aSingleLink successor: aSingleLink successor successor. ].
   count ← count − 1.
   ↑ anObject.

internal
initialize | | super initialize. firstLink ← nil.
firstLink  | | ← firstLink.
```

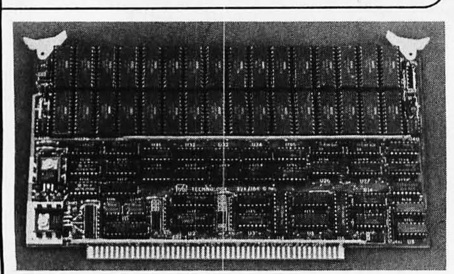
Table 8: *Class template for class* SinglyLinkedList.



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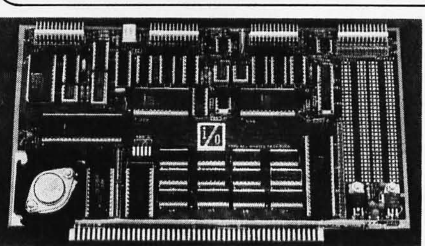
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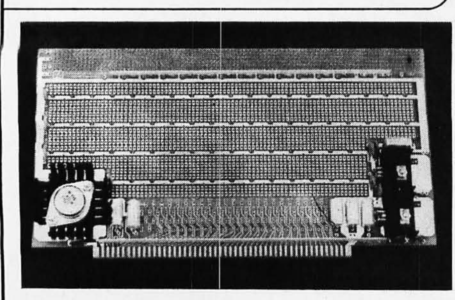
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former first link in the list. This procedure is used to implement the message insert:At: in class SinglyLinkedList. We also increment the value of count, just as we do in the message append.

The general procedure for removing a data item from a singly linked list is analogous to that for inserting an item. First we find the link that precedes the one at the position of interest. We then point this link to the link that follows the one of interest. This deletes the link of interest from the list (see figure 6b). We then return the entry of the deleted link. Again, the exceptional case is removing the first item since there is no preceding link. The message removeAt: in class SinglyLinkedList is implemeneted using this procedure. Since an object has been deleted from the list, we decrement the value of count.

Suppose we wish to use a singly linked list instead of a sequential list in our previous example of a deck of cards. We simply create instances of class SinglyLinkedList for the deck and hands, as shown in the following:

```
| hand1 hand2 deck |
deck ← SinglyLinkedList new.
hand1 ← SinglyLinkedList new.
hand2 ← SinglyLinkedList new.
```

We can then use the rest of the code, unchanged, from that example. We are able to do this because we have hidden the details of each implementation inside the corresponding class definition and, in using the classes, have limited ourselves to a clearly defined set of external messages.

The Circular List

Another type of linked list is the *circular list* (see figure 7). A circular list is a singly linked list in which the successor of the last link in the list is the first link in the list. This makes a circular chain of links. If we have access to the last link in a circular list, then we also have easy access to the first link of that list since it is the immediate successor of the last link. By keeping track of the last link of a circular list, we can easily insert and remove items from both the begin-

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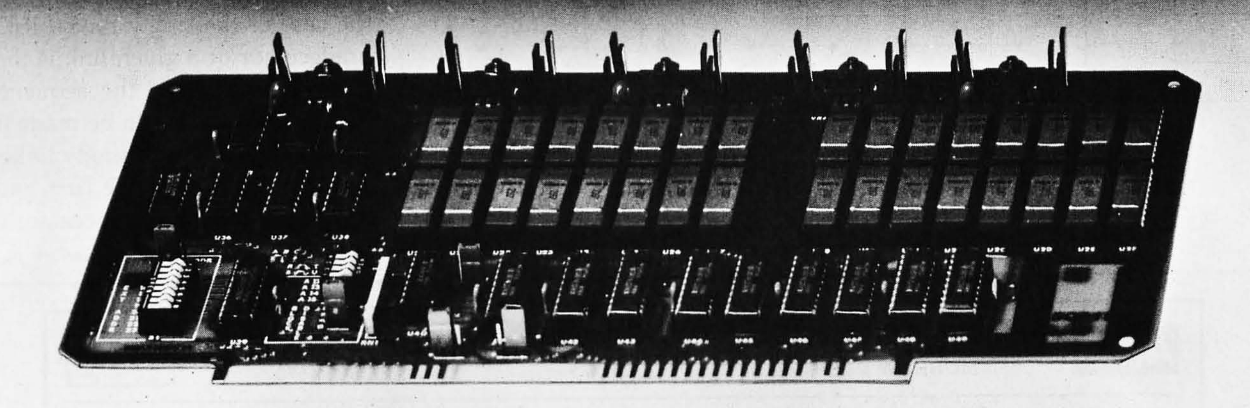
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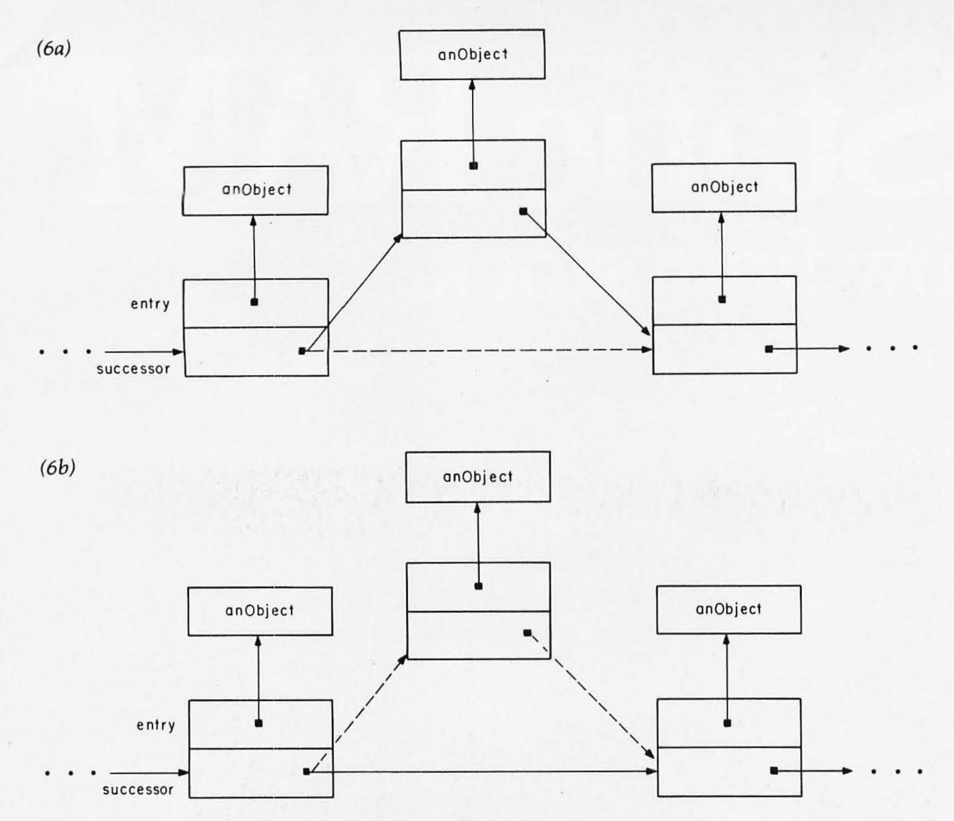


Figure 6: *The insertion and deletion of data items from a singly linked list. In both insertion (6a) and deletion (6b) processes, the dotted lines represent the links existing before the process, while the solid lines represent the links existing after the process.*

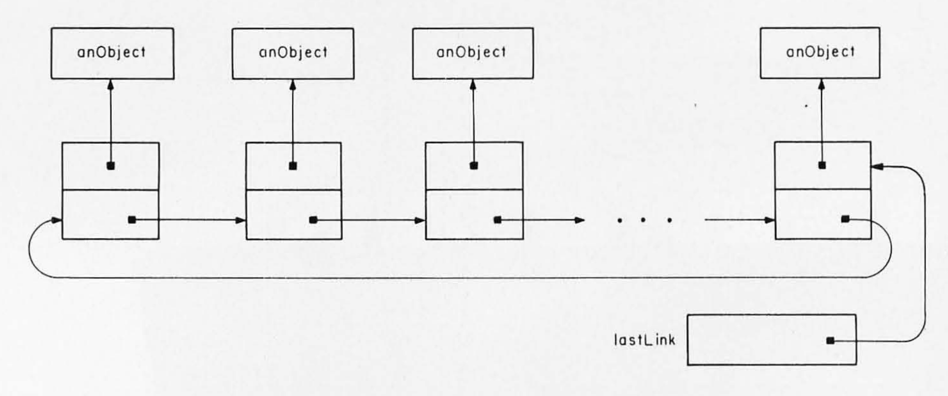


Figure 7: *A circular list.*

ning and the end of the list. This will be a useful property in some of the data structures that we will build out of circular lists.

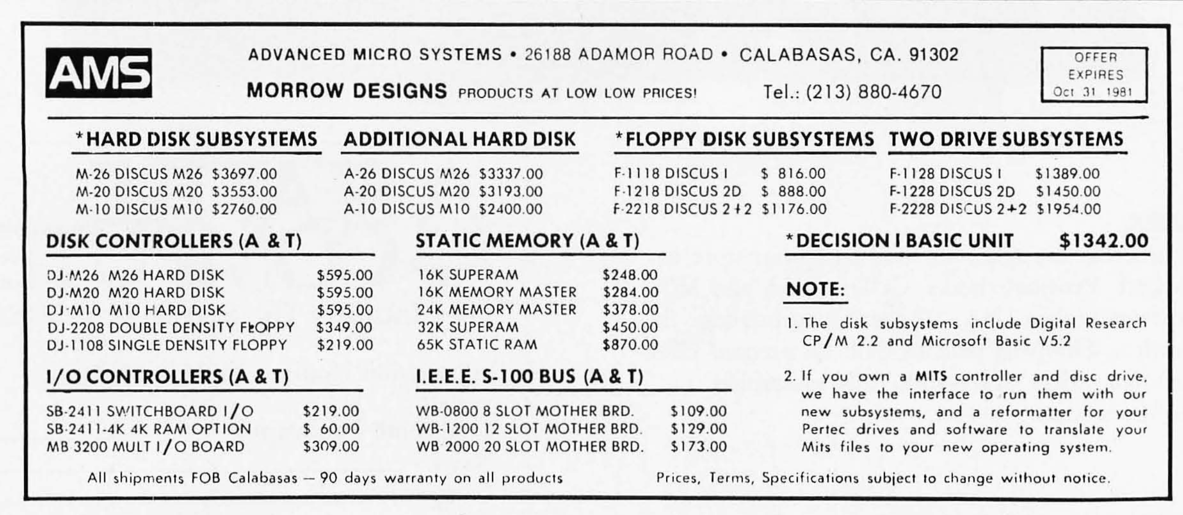
The definition of class CircularList is given in table 9. Class CircularList has an instance variable named lastLink that points either to the last link in the list or to nil if the list is empty. The internal message initialize sets lastLink to nil. The internal message firstLink (again, as in the case of class SinglyLinkedList, sent to nonempty lists only) returns the successor of lastLink. Since the list is circular, this is the first link in the list.

The append, insert, and remove operations on a circular list are similar to those on a noncircular list. Since we always have a link that precedes any given link in a circular list, we don't have to make exceptions for operations on the beginning of the list. The implementation of these operations is demonstrated in the methods for the messages append:, insertAt:, and removeAt:.

The Doubly Linked List

Now we will consider the *doubly linked list* (see figure 8). A doubly linked list is a sequence of double links connected together. The successor of a given link is the link that follows it in the sequence, just as in the case of the singly linked list. The predecessor of a given link is the link that precedes it in the sequence. A doubly linked list can be made into a circular list, just as a singly linked list can, by connecting the first and last links. In this case, the successor of the

Text continued on page 260



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class name	CircularList
superclass	LinkedList
instance variable names	lastLink
class messages and methods	

"none defined here"

instance messages and methods

```
external
append: anObject | aSingleLink |
   self empty
      ifTrue: [ lastLink ← SingleLink entry: anObject successor: nil.
         lastLink successor: lastLink. ]
      ifFalse: [ aSingleLink ← SingleLink
         entry: anObject successor: lastLink successor.
         lastLink successor: aSingleLink. lastLink ← aSingleLink. ].
   count ← count + 1.
insert: anObject at: anInteger | aSingleLink |
   self checkIndex: anInteger.
   aSingleLink ← self linkAt: anInteger − 1.
   aSingleLink successor:
   (SingleLink entry: anObject successor: aSingleLink successor).
   count ← count + 1.
removeAt: anInteger | aSingleLink anObject |
   self checkIndex: anInteger.
   aSingleLink ← self linkAt: anInteger − 1.
   anObject ← aSingleLink successor entry.
   (count = 1)
      ifTrue: [ lastLink ← nil. ]
      ifFalse: [ aSingleLink successor: aSingleLink successor successor.
         (anInteger = count) ifTrue: [ lastLink ← aSingleLink. ]. ].
   count ← count − 1.
   ↑ anObject.

internal
initialize | | super initialize. lastLink ← nil.
firstLink | | ↑ lastLink successor.
linkAt: anInteger | |
   (anInteger = count) | (anInteger = 0) ifTrue: [ ↑ lastLink ].
   ↑ super linkAt: anInteger.
```

Table 9: *Class template for class* CircularList.

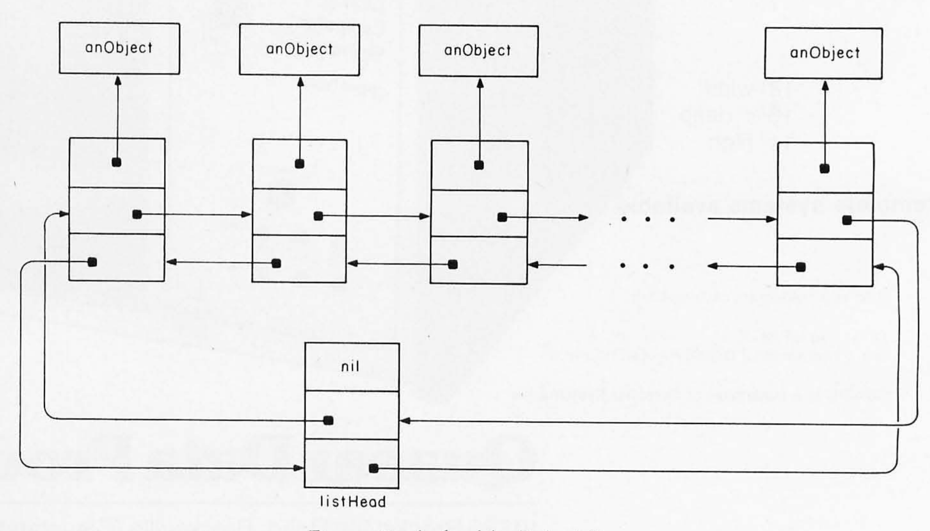


Figure 8: *A doubly linked list.*

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class name	DoublyLinkedList
superclass	LinkedList
instance variable names	listHead
class messages and methods	

```
"none defined here"
```

instance messages and methods

```
external
append: anObject | | self insert: anObject after: listHead predecessor.
insert: anObject at: anInteger | |
    self checkIndex: anInteger.
    self insert: anObject after: (self linkAt: anInteger − 1).
removeAt: anInteger | aDoubleLink |
    self checkIndex: anInteger.
    aDoubleLink ← self linkAt: anInteger.
    aDoubleLink successor predecessor: aDoubleLink predecessor.
    aDoubleLink predecessor successor: aDoubleLink successor.
    ↑ aDoubleLink entry.

internal
initialize | |
    super initialize.
    listHead ← DoubleLink entry: nil successor: nil predecessor: nil.
    listHead successor: listHead. listHead predecessor: listHead.
firstLink | | ↑ listHead successor.
linkAt: anInteger | aDoubleLink |
    (anInteger = 0) ifTrue: [ ↑ listHead ].
    (anInteger < = (count / 2)) ifTrue: [ ↑ super linkAt: anInteger ].
    aDoubleLink ← listhead.
    (count − anInteger + 1) timesRepeat:
    [ aDoubleLink ← aDoubleLink predecessor. ].
    ↑ aDoubleLink.
insert: anObject after: aDoubleLink1 | aDoubleLink2 |
    aDoubleLink2 ← DoubleLink entry: anObject
        successor: aDoubleLink1 successor predecessor: aDoubleLink1.
    aDoubleLink1 successor: aDoubleLink2.
    aDoubleLink2 successor predecessor: aDoubleLink2.
```

Table 10: *Class template for class* DoublyLinkedList.

Text continued from page 256:

last link is the first link, and the predecessor of the first link is the last link. The class definition for a circular, doubly linked list is given in table 10.

Class DoublyLinkedList has an instance variable named listHead, which points to a special kind of link known as a *list head*. A list head is a link whose entry is unused. The idea is to keep the list head in the list so that even when there are no data items in the list, at least one link is present. Having a link present at all times simplifies the implementation of some linked list operations. A list head can be used in the implementation of a singly linked list, but it is especially convenient in the implementation of a circular doubly linked list. In a circular doubly linked list, the list head successor points to the first link in the list (excluding the list head itself), or to itself if the list is empty (see figure 9). The list head predecessor points to the last link in the list (excluding the list head itself), or to itself if the list is empty. In class DoublyLinkedList, the internal message initialize sets listHead to an instance of DoubleLink whose entry is nil and whose successor and predecessor are both that same in-

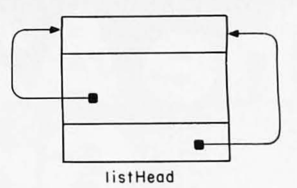


Figure 9: *An empty doubly linked list.*

stance (ie: the double link is made circular). The message firstLink has been modified to return the list head successor.

Because a doubly linked list is composed of a sequence of double links, it is possible to traverse the list in both directions, forward and backward, with equal facility. The internal message linkAt: in class DoublyLinkedList has been modified to access objects past the middle of the list by starting from the rear and traversing toward the front. This improves the performance of the access message at:.

Inserting an item in a doubly linked list is similar to inserting an item in a singly linked list. We first create a new link for the item. Then we find the link that this new link is to follow, set the successor and predecessor pointers of the new link, and adjust both the successor pointer of the link that precedes the new link and the predecessor pointer of the link that follows the new link (see figure 10a). If we are using a circular list with a list head, we don't have to consider any exceptional cases. Removing an item from a list is an analogous process (see figure 10b). The details of these procedures are demonstrated in the methods for the messages append:, insert:, and removeAt:.

The Stack

The next data structure that we will look at is the *stack* (see figure 11). A stack is a linear list of items that is accessed in a very restricted way. In fact, only one side of a stack, the *top*, can be accessed. The *bottom* of the stack cannot be accessed. These names are useful because most stack diagrams list their items vertically, with the accessible end higher. The item at the accessible end of the stack

Text continued on page 264

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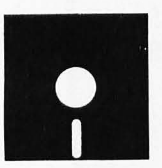
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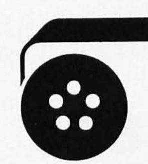
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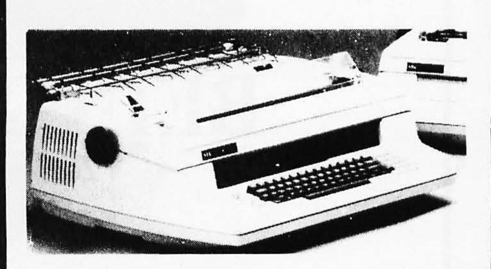
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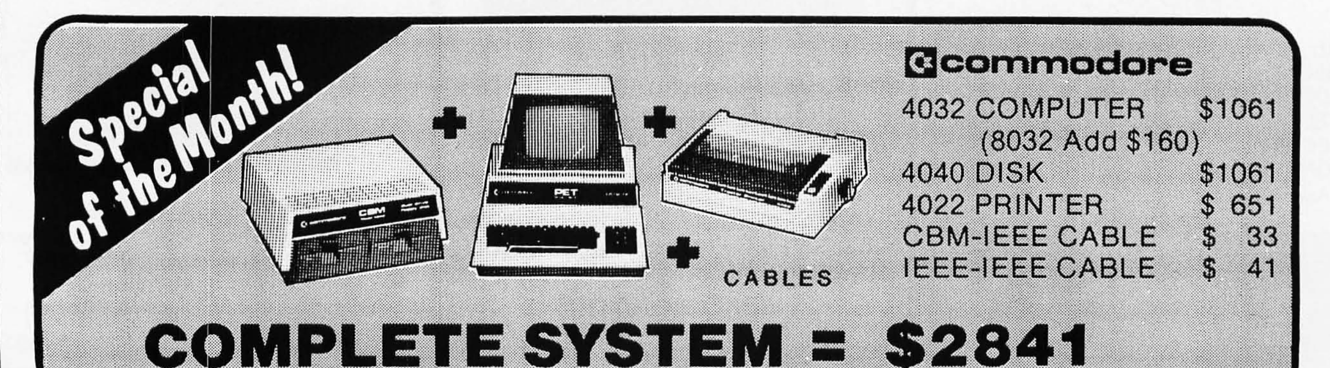
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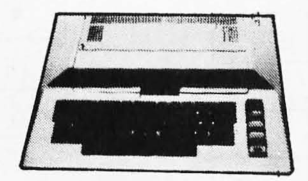
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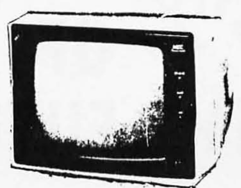
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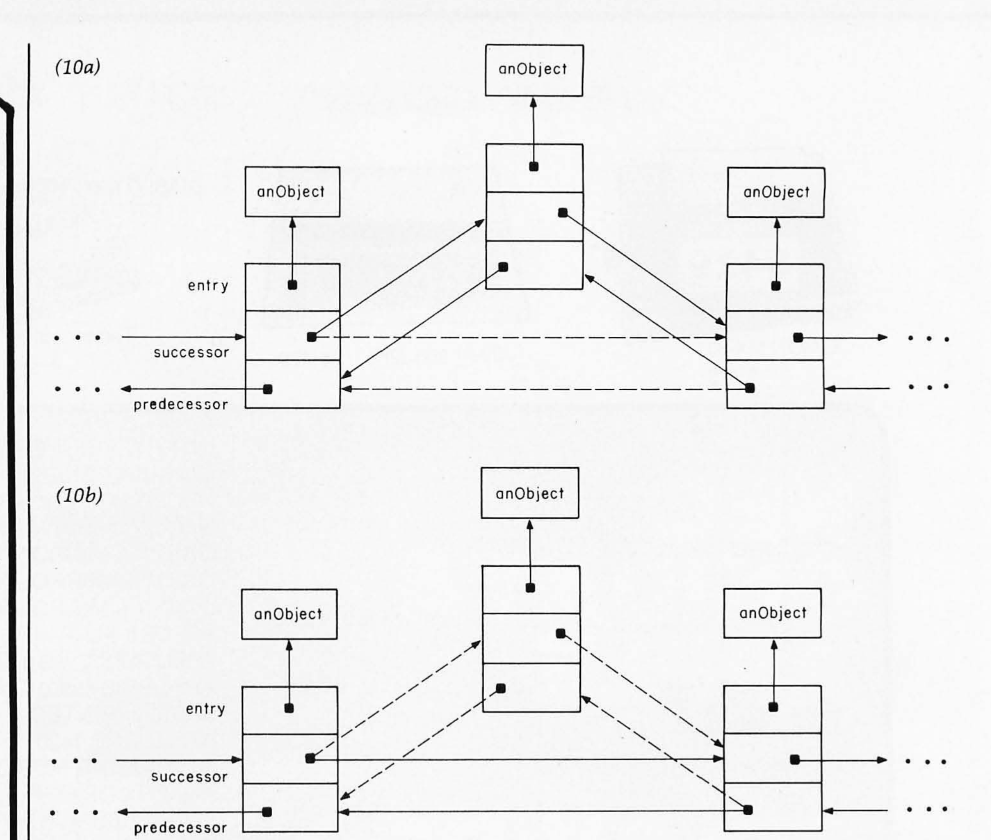



Figure 10: *The insertion and deletion of data items from a doubly linked list. In both insertion (10a) and deletion (10b) processes, the dotted lines represent the links existing before the process, while the solid lines represent the links existing after the process.*

Text continued from page 260:
is called the *top item*. A new item is added to the accessible end, thereby making it the new top item. This is called *pushing* an item onto a stack. Only the top item can be removed, or *popped*, from a stack. By adding and removing in this fashion (pushing and popping), we are able to access items in a last-in-first-out manner—that is, the last item pushed on a stack is the first item to be popped off the stack. Because of this, a stack is often called a *LIFO* (last-in-first-out).

Many examples of collecting and accessing in stack fashion exist outside the realm of programming. A pile of trays in a cafeteria rack is often used in this way. The same can be true of papers piled on a desk. In programming systems, a number of algorithms call for the use of a stack. For example, arithmetic expressions expressed in prefix or postfix notation can be evaluated using a stack to keep track of partial results.

The operations that we want to perform on a stack include:

- determine the number of items on the stack
- determine whether or not the stack is empty
- push an item onto the stack
- pop an item off the stack
- access the top item on the stack

It is easy to implement a stack using a linear list as the basic storage mechanism. Since we have several kinds of linear lists, it is possible to have several different stack implementations. Table 11 gives the definition of class Stack, which serves as a superclass for subsequent stack classes. Each kind of stack has a buffer which is a linear list, either sequential or linked. The messages count and empty are implemented using the corresponding messages of the linear list. The message emptyCheck, which sends an error message if the stack is empty, will be used in the implementations of the messages pop and top.

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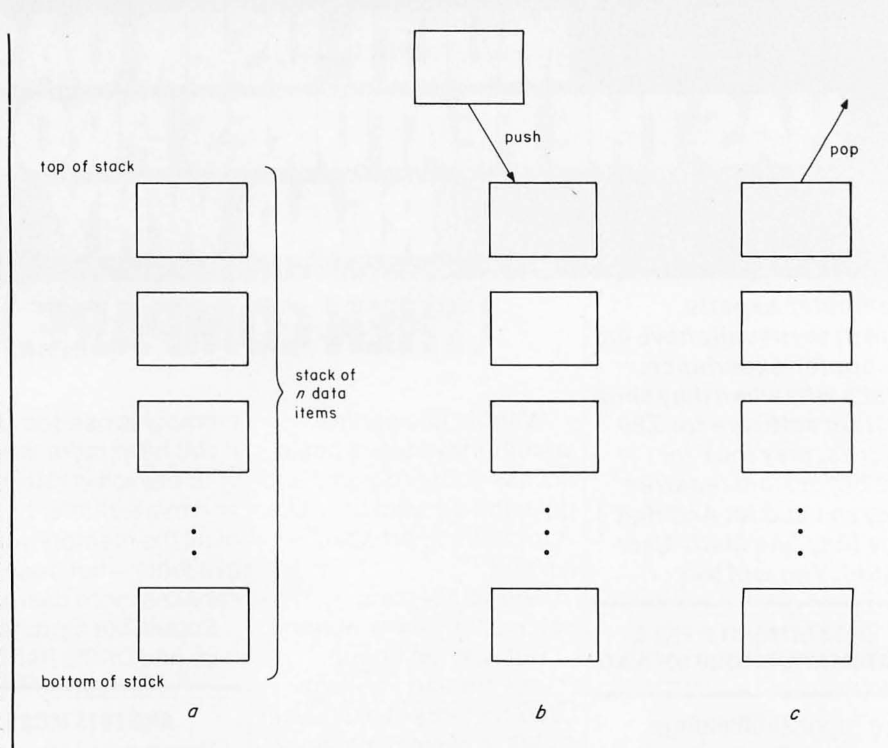


Figure 11: *A stack, shown in figure 11a, is a linear collection of objects arranged so that items can be added to or removed from the stack only at the top end of the stack. Figure 11b shows an item being added, or pushed, to the stack. Figure 11c shows an item being taken, or popped, from the stack.*

will consider is the *sequential stack*. A sequential stack is simply a stack implemented using a sequential list. The definition of class SequentialStack is given in table 12. An instance of SequentialStack is created by sending class SequentialStack the message size:, whose parameter is an integer indicating the estimated maximum size of the stack. For example:

```
| stack |
stack ← SequentialStack size: 20.
```

creates an instance of SequentialStack with space initially for twenty items. This size is expanded when necessary since the sequential list used as a buffer is expanded when required.

The message push: is implemented by appending to the buffer the object passed as a parameter. As we have noted, this is an easy operation for sequential lists to perform, except when the list overflows and requires expansion. The message pop is implemented by first checking to see if the buffer is empty, in which case an error is reported. Otherwise, the last item from the buffer is removed. Again, we should recall that this is an easy operation for a sequential list to perform. Similarly, in order to access the top of the stack (using the message top), we check to see that the stack is not empty, in which case we return (without removing) the last item in the buffer.

The following is an example using class SequentialStack:

```
| stack a b c |
stack ← SequentialStack size: 10.
a ← (Card suit: 'heart' rank: 5).
b ← (Card suit: 'heart' rank: 6).
c ← (Card suit: 'heart' rank: 7).
stack push: a.
stack push: b.
stack push: c.
a ← stack pop.
b ← stack pop.
c ← stack pop.
```

This example creates an instance of class SequentialStack that initially has space for ten objects. The variables a, b, and c are assigned to instances of class Card with ranks 5, 6, and 7, respectively. These instances are pushed on the stack and then popped

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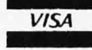
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class name	Stack
superclass	Object
instance variable names	buffer
class messages and methods	
"none defined here"	
instance messages and methods	

```
external
count | | ↑ buffer count
empty | | ↑ buffer empty
"push: anObject | | ... to be defined in subclasses"
"pop | | ... to be defined in subclasses"
"top | | ... to be defined in subclasses"

internal
emptyCheck | | self empty ifTrue: [ ↑ self error: 'stack empty' ].
```

Table 11: *Class template for class* Stack.

class name	SequentialStack
superclass	Stack
instance variable names	"none defined here"
class messages and methods	

```
size: anInteger | |
    (anInteger > 0)
     ifTrue: [ ↑ (self new) initialize: anInteger ]
     ifFalse: [ ↑ self error: 'invalid size' ].
```

instance messages and methods

```
external
push: anObject | | buffer append: anObject.
pop | | self emptyCheck. ↑ buffer removeAt: buffer count.
top | | self emptyCheck. ↑ buffer at: buffer count.

internal
initialize: anInteger | | buffer ← SequentialList size: anInteger.
```

Table 12: *Class template for class* SequentialStack.

off. The effect is to reverse the assignments to a, b, and c, such that the ranks are 7, 6, and 5, respectively.

The Linked Stack

Alternatively, we can define a *linked stack*, which is a stack whose buffer is a linked list. The definition of class LinkedStack is given in table 13. A linked stack is created by sending the message new to class LinkedStack. Since we are using a linked list for the buffer, there is no need to specify a maximum size estimate. For example:

```
| stack |
stack ← LinkedStack new.
```

creates a new instance of class

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class name	LinkedStack
superclass	Stack
instance variable names	"none defined here"
class messages and methods	

new | | ↑ (super new) initialize

instance messages and methods

external
push: anObject | | buffer insert: anObject at: 1.
pop | | self emptyCheck. ↑ buffer removeAt: 1.
top | | self emptyCheck. ↑ buffer at: 1.

internal
initialize | | buffer ← LinkedList new.

Table 13: *Class template for class* LinkedStack.

LinkedStack. The message push: is implemented by inserting the object passed as a parameter at the beginning of the buffer (ie: at position number 1). This is an easy operation for a singly linked list. The message pop is done by removing the first object from the buffer—another easy operation. The message top is implemented by accessing the object that is the entry of the first link of the buffer. We can use an instance of class LinkedStack in the example given for class SequentialStack by doing the following:

```
| stack |
stack ← LinkedStack new.
...
```

The rest of the example is unchanged.

The Queue

The *queue* is an important data structure that, like the stack, occurs often both in programming systems and outside the realm of programming (see figure 12). A queue is a linear list of items whose access is restricted to the two ends. An item can be appended to only one end of a queue, called the *rear*. An item can be removed only from the other end of the queue, called the *front* of the queue. This causes a sequence of items that are added to a queue and subsequently removed, to be accessed in a strict first-in-first-out fashion (ie: the first item that we put in a queue is the first item that we get out). Because of this, a queue is sometimes called a *FIFO* (first-in-first-out).

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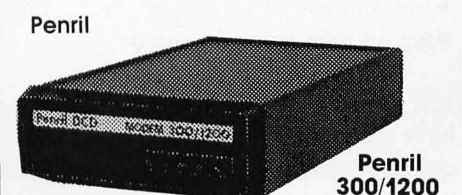
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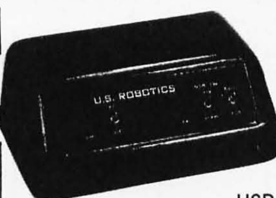
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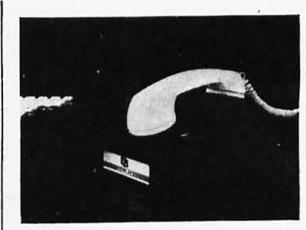
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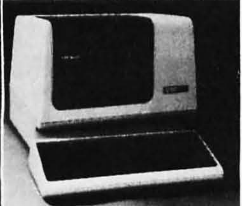
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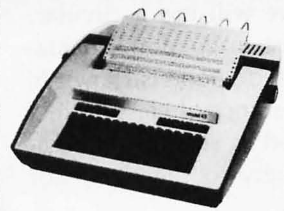
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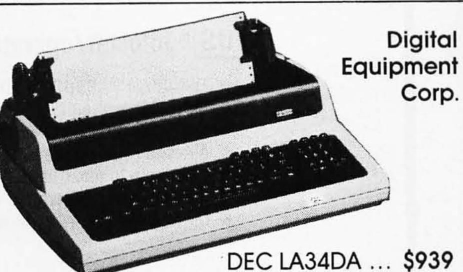


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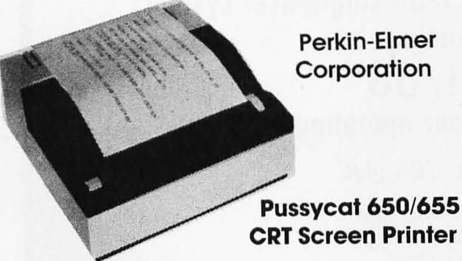
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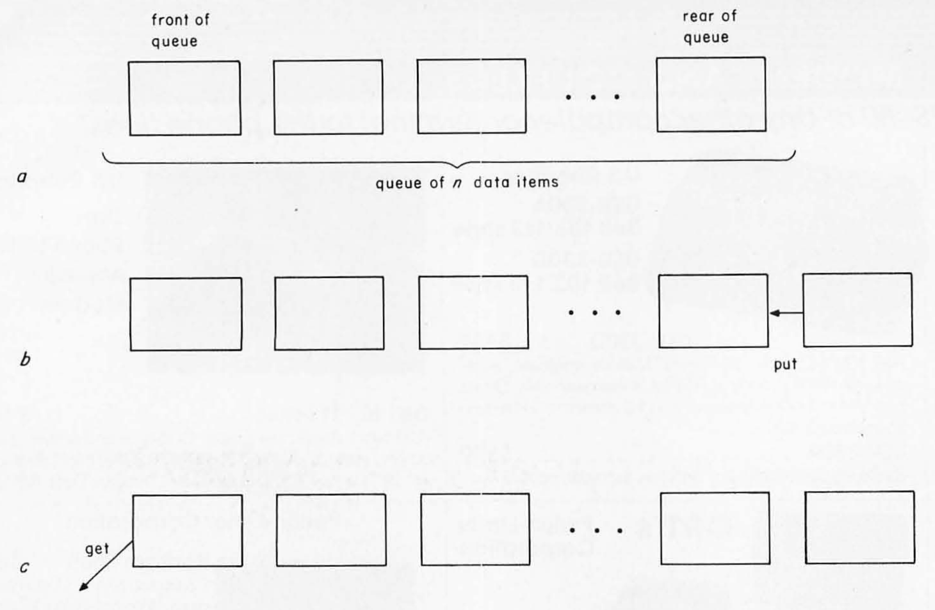


Figure 12: *A queue (12a) is a linear collection of objects arranged so that items can be added (or put) only at the rear of the queue (12b) and taken away (or gotten) only at the front of the queue (12c).*

dow or checkout counter are everyday examples of this kind of discipline. In programming systems, queues are used for many purposes, for example, to represent a line of customers in a simulation program or to handle ordered lists of events and processes in operating systems.

The operations we want to perform on a queue include:



- determine the number of items in the queue
- determine whether or not the queue is empty
- put an item in the queue
- get an item from the queue

Just as in the case of the stack, we can have different implementations of the queue depending on the type of buffer we use for storing the data items. Class Queue, which serves as a superclass for the queue classes, is given in table 14. Class Queue contains an instance variable named buffer that points to the object that provides the storage for items in the queue. The external messages have been listed to show what must be defined in all subclasses. The message emptyCheck, which sends an error message if the queue is empty, will be used in the implementation of get.

The Linked Queue

The first queue we will consider is the *linked queue*. A linked queue is one whose buffer is a linked list. Because we want to remove and add items easily, we will use a circular, singly linked list in our implementation. Class LinkedQueue is shown in table 15. An instance of class LinkedQueue is created by sending the creation message new to the class. For example:

```
| queue |
queue ← LinkedQueue new.
```

creates and initializes a new linked queue. The internal message initialize creates a new instance of CircularList and stores a pointer to it in buffer.

To put an object in a linked queue we use the message put:, passing the object as the parameter. This object is then added to the circular list by sending buffer the message append:. Similarly, the next object can be removed by using the message get. The method for get first checks to see if buffer is empty. If it is, an error message is sent. If not, the first object is removed from buffer and returned.

The messages count and empty are implemented by sending the respective messages to buffer and returning

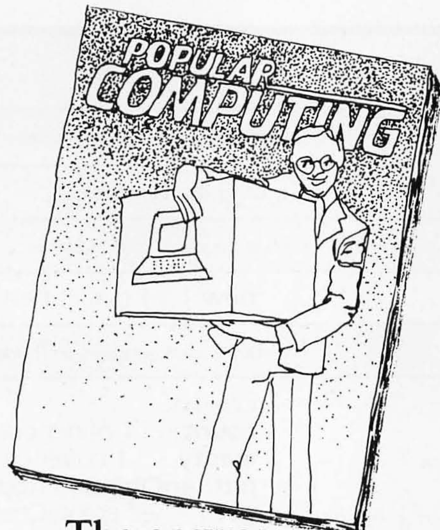
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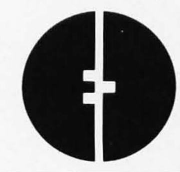
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class name	Queue
superclass	Object
instance variable names	buffer
class messages and methods	
"none defined here"	
instance messages and methods	

```
external
"count | | ... to be defined in subclasses"
"empty | | ... to be defined in subclasses"
"put: anObject | | ... to be defined in subclasses"
"get | | ... to be defined in subclasses"

internal
emptyCheck | | self empty ifTrue: [ ↑ self error: 'queue empty' ].
```

Table 14: *Class template for class* Queue.

class name	LinkedQueue
superclass	Queue
instance variable names	"none defined here"
class messages and methods	

```
new | | ↑ (super new) initialize.
```

instance messages and methods	

```
external
count | | ↑ buffer count.
empty | | ↑ buffer empty.
put: anObject | | buffer append: anObject.
get | | self emptyCheck. ↑ buffer removeAt: 1.

internal
initialize | | buffer ← CircularList new.
```

Table 15: *Class template for class* LinkedQueue.

the result. A simple example of the use of LinkedQueue is the following:

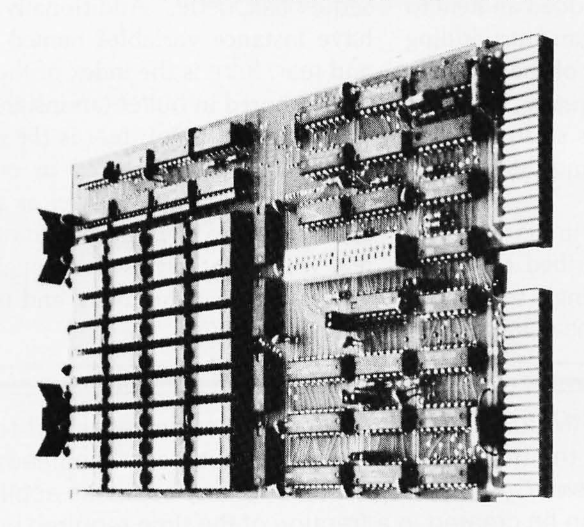
```
| queue a b c |
queue ← LinkedQueue new.
a ← (Card suit: 'heart' rank: 5).
b ← (Card suit: 'heart' rank: 6).
c ← (Card suit: 'heart' rank: 7).
queue put: a.
queue put: b.
queue put: c.
a ← queue get.
b ← queue get.
c ← queue get.
```

This sequence creates an instance of class LinkedQueue and assigns to the variables a, b, and c, instances of class Card with ranks 5, 6, and 7, respectively. These instances are put into the queue in the order listed and are then removed and assigned to the variables a, b, and c. The original order is preserved; the ranks of a, b, and c are 5, 6, and 7, respectively.

The Sequential Queue

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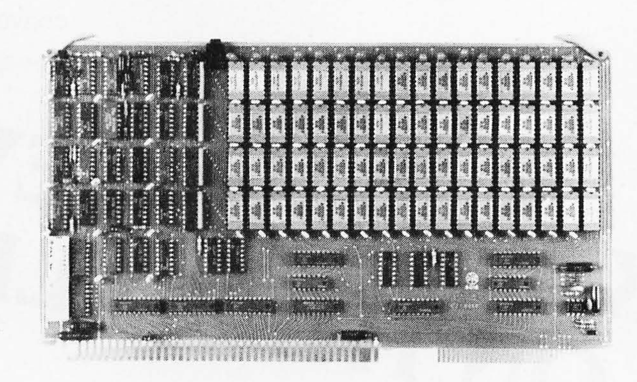
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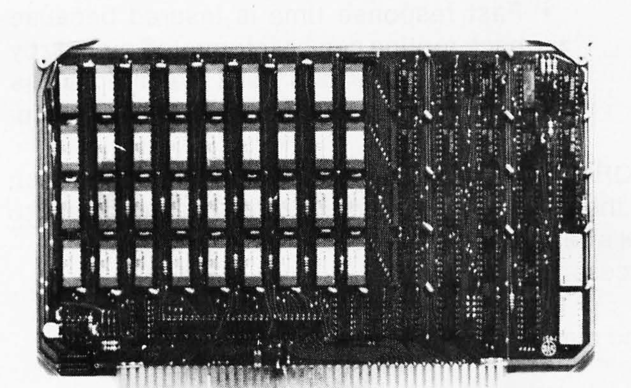
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one that uses a sequential list to store data items. Unfortunately, a sequential list is not well suited to this purpose, because we need to add items to one end of the list and remove them from the other. You will recall that adding items to the end of a sequential list is an easy operation, but removing them from the beginning is difficult since we have to copy forward all of the succeeding items in the list. Rather than copy forward all items after the first, we would prefer to ignore the item at position 1 of the list and consider the item at position 2 to be the first item in the list. The problem, however, is that as items are added and removed from the list, the actual positions of the first and last items migrate toward the end of the list. This could cause the list to expand even if it is not full. Fortunately, we can treat the last position in the list as if it preceded the first position: that is, we consider the list to be circular. After we have added an item to the last position, we can start adding items to the beginning of the list, provided some have already been removed. If we use this strategy, then we don't have to expand the list until it is full.

The class definition in table 16 uses the strategy just described to implement a queue using sequential storage. Class SequentialQueue uses an instance of class IndexedTable as its buffer. Since class IndexedTable does not provide facilities for counting the number of objects stored in an instance (those facilities are provided by class LinearList), we need to define an instance variable count in class SequentialQueue. Additionally, we have instance variables named front and rear. front is the index of the first object stored in buffer (an instance of class IndexedTable); rear is the index of the last object stored in buffer. Since we are treating buffer as a circular sequence of positions, front and rear will repeatedly cycle through the values between the lower and upper bounds of buffer.

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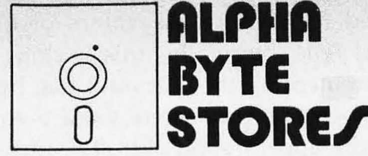
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class name	SequentialQueue
superclass	Queue
instance variable names	front rear count
class messages and methods	

```
size: an Integer | |
    (anInteger < 1) ifTrue: [ ↑ self error: 'invalid size' ].
    ↑ (self new) buffer: (IndexedTable from: 1 to: anInteger) count: 0.
```

instance messages and methods

```
external
count | | ↑ count.
empty | | ↑ count = 0.
put: anObject | |
    (count = buffer size) ifTrue: [ self expand. ].
    buffer put: anObject at: rear.
    rear ← self advance: rear.
    count ← count + 1.
get | anObject
    | self emptyCheck.
    anObject ← buffer at: front.
    front ← self advance: front.
    count ← count − 1.
    ↑ anObject.

internal
buffer: anIndexedTable count: anInteger | |
    buffer ← anIndexedTable. count ← anInteger.
    front ← buffer lowerBound. rear ← front + count.
advance: anInteger | |
    anInteger = buffer upperBound
        ifTrue: [ ↑ buffer lowerBound ] ifFalse: [ ↑ anInteger + 1 ].
expand | anIndexedTable anInteger |
    anIndexedTable ← IndexedTable from: 1 to: (2 * buffer size).
    anInteger ← front.
    1 to: count do:
        [: i | anIndexedTable put: (buffer at: anInteger) at: i.
        anInteger ← self advance: anInteger. ].
    self buffer: anIndexedTable count: count.
```

Table 16: *Class template for class* SequentialQueue.

Because we are using an instance of class IndexedTable for storing objects, we must specify an estimate of the maximum size of an instance of class SequentialQueue when we create it. This is done with the creation message size:, which creates a new instance of SequentialQueue and sends it the internal messsage buffer:count:. The first parameter of buffer:count: is an instance of class IndexedTable; the second is the number of objects stored in the first parameter (initially zero).

The message buffer:count: is also sent from the internal message expand, which is used to expand buffer when it becomes full. expand is implemented by creating a new instance of IndexedTable that is twice as large as the current one. All of the objects stored in buffer are copied to the first half of the new instance, which then becomes the new buffer.

The internal message advance is used to advance the values of front and rear. Normally, this is done by incrementing the current value by 1. However, if the current value is equal to the upper bound of buffer, then we must set the value back to the lower bound of buffer. The external messages are those specified in the superclass Queue. The message count returns the value of the instance variable count. The message empty tests to see if count is zero.

For the message put:, we first test to see if buffer is full. If buffer is full, it is expanded using the message expand. The object passed as a parameter to put: is then stored in buffer at the position indicated by rear. rear is then advanced one position forward, using the message advance. Finally, the value of count is incremented.

Similarly, for the message get, we first test to see if the queue is empty. If it is, an error message is sent; otherwise, the object stored at the position indicated by front is removed from buffer. front is advanced one position forward, and the value of count is decremented. Finally, the removed object is returned.

Summary

The class construct is an extremely useful tool for implementing data structures. Implementing a data structure with a class makes it possible to confine the details of the implementation to one place and to insure that the resulting object will be accessed by the rest of the system in a secure manner, namely, through the use of a set of messages that correspond to the operations that are well defined for that data structure. Additionally, the ability to create subclasses makes it possible to share variables and methods among similar class definitions, thereby reducing the amount of work needed to implement a set of data structures. ■

References

1. Horowitz, E and Sartaj, S. *Fundamentals of Data Structures*. Potomac MD: Computer Science Press, 1976.
2. Knuth, D E. *The Art of Computer Programming: Volume 1/Fundamental Algorithms*, Second Edition. Reading MA: Addison-Wesley, 1973.
3. Robson, D and Goldberg, A. "The Smalltalk-80 System," August 1981 BYTE, page 36.
4. Wirth, N. *Algorithms + Data Structures = Programs*. Englewood Cliffs NJ: Prentice-Hall, 1976.

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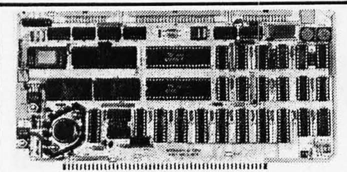
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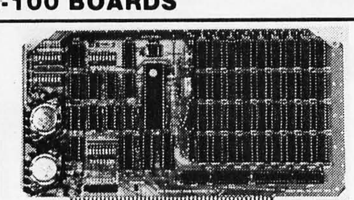
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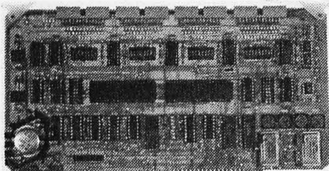
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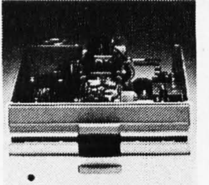
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MFG.	MODEL #	PRICE
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CPU-1	8080A CPU	$31.95

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PART #	SIDES/DENSITY	SECTORING	PRICE
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20 PIN TIN ST	.25	.23	.21	.20
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IBM Format		
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Per Track	3328	6656
Transfer Rate	250 kilobit/sec	500 kilobits/sec
Latency (avg.)	83 ms	83 ms
Access Time		
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Average	260 ms	260 ms
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Continued from page 34:

Venice, *only to find the wares* Much Ado About Nothing, *or even* The Comedy of Errors? *Or, after conceiving a program during* A Midsummer Night's Dream, *who has not labored until the* Twelfth Night *just to get the output* As You Like It? . . . **CPF**

Modification Caveat

While I especially enjoyed the article "What's Inside Radio Shack's Color Computer" (March BYTE 1981, page 90), there is a problem I would like to pass on to other BYTE readers.

The authors indicated that the processor speed can be doubled by issuing a POKE 65495,0 command. Before I had my computer upgraded for Extended Color BASIC, I used this method to make programs run faster. But after getting the Extended BASIC upgrade, I had problems with double speed. During program execution, everything worked. But if the machine was still operating at double speed when the program ended, the computer would hang up, requiring me to reset it. (I solved this by restoring the normal speed with POKE 65494,0 before the program ended.) But if the program ended unexpectedly, before I could restore normal speed, the computer would hang up.

Richard A Schafer
POB 1171
Fond du Lac WI 54935

The people at Radio Shack advise us that the processor and other parts are designed for 1 MHz operation, and that any time you try to double this speed, you're inviting problems. The reason you had problems with Extended BASIC at the higher speed is that it keeps certain parts (eg: processor and the peripheral interface adapter) busier than non-Extended BASIC does. At 2MHz, these parts are overloaded. . . . **GS**

Define the Problem

I read Gregg Williams's "Is This Really Necessary? A First Look at Design Techniques" (March 1981 BYTE, page 6) with interest. Concerning the lifespan of a medium-sized system (described on page 8), the first phase will also be called *system and problem analysis* instead of (system) design.

In the *system analysis*, the system environment is studied and all the parameters that have an influence on the system are résuméd and their interrelation is defined (perhaps using decision tables). In the *problem analysis*, the designer must devise alternative schemes to solve the problem and choose the best approach. By the end of the analysis, the system has been completely specified (hardware and software). But, more important than the designation of the different phases is the fact that, as Mr Williams mentioned, the designer must at first respond to the "what" of the question. In practice, most people try to solve a problem before it has been specified.

The importance of the analysis/specification and design phases in a well-managed project is shown by T H Bruggere in his article "On-Schedule, Reliable Software Depends on Sound Methodology" (*EDN* January 7, 1981).

Finally, in the references, Mr Williams failed to mention M A Jackson's *Principles of Program Design* (New York: Academic

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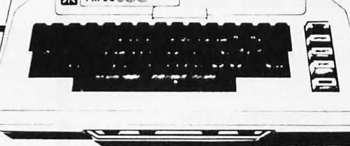
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Press, 1975), which shows how to correctly dissect a problem. In his method, the program structure is based on the data structure that is first defined.

Roland Vannay
Kirchweg 43a
5415 Nussbaumen
Switzerland

Correction

I want to correct an inaccuracy in Chris Morgan's editorial in the May 1981 BYTE. (See "How Can We Stop Software Piracy?", page 6.) RCS/MicroModeller was developed in the United States by Ferox Microsystems Inc (Falls Church, Virginia) and is marketed in England by Intelligence (UK) Limited. RCS has been marketed in the United States and Canada under the name Micro DSS/F by Addison-Wesley Publishing Company since June, 1981.

Any BYTE readers interested in further information about RCS should contact Phil Evans, our vice-president of marketing, at the address below or call him at (800) 336-4766; in Virginia (703) 998-0330.

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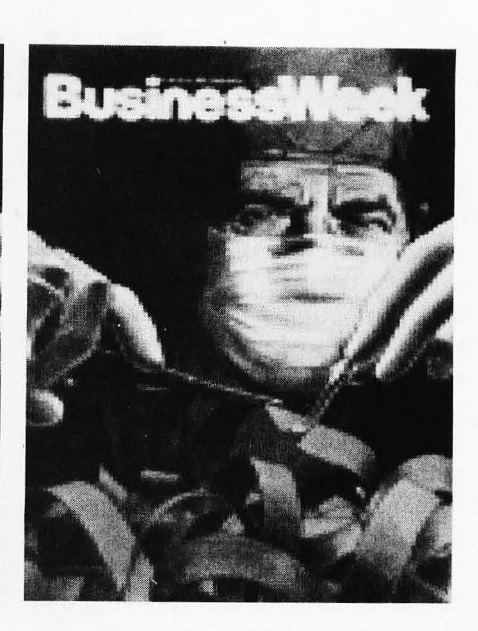
"The Epson MX-80 and MX-70 Printers" was a very informative article. (See the May 1981 BYTE, page 22.) However, I called Epson in Great Neck, New York, to see if I could get David Lien's *MX-70 User's Manual*, as mentioned on page 30, and I was told it does not exist! Does BYTE know something Epson doesn't? If so, how can I get this manual?

Richard FitzHugh
3806 Everett St
Kensington MD 20795

Early shipments of Epson printers were not accompanied by a user's manual. Owners of Epson printers can obtain a user's manual, free of charge, by contacting Kari Westlake, Epson America Inc, 23844 Hawthorne Blvd, Torrance CA 90505, (213) 378-2220. . . . **MH**■

Begin at square one.



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Sources: BW Profile '81. MRI (Spring 1981)



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Design Principles Behind Smalltalk

Daniel H H Ingalls
Learning Research Group
Xerox Palo Alto Research Center
3333 Coyote Hill Rd
Palo Alto CA 94304

The purpose of the Smalltalk project is to provide computer support for the creative spirit in everyone. Our work flows from a vision that includes a creative individual and the best computing hardware available. We have chosen to concentrate on two principal areas of research: a language of description (programming language) that serves as an interface between the models in the human mind and those in computing hardware, and a language of interaction (user interface) that matches the human communication system to that of the computer. Our work has followed a two- to four-year cycle that can be seen to parallel the scientific method:

- Build an application program within the current system (make an observation)
- Based on that experience, redesign the language (formulate a theory)
- Build a new system based on the new design (make a prediction that can be tested)

The Smalltalk-80 system marks our fifth time through this cycle. In this article, I present some of the general principles we have observed in the course of our work. While the presentation frequently touches on Smalltalk "motherhood," the principles themselves are more general and should prove useful in evaluating other systems and in guiding future work.

Just to get warmed up, I'll start with a principle that is more social than technical and that is largely responsible for the particular bias of the Smalltalk project:

Personal Mastery: *If a system is to serve the creative spirit, it must be entirely comprehensible to a single individual.*

The point here is that the human potential manifests itself in individuals. To realize this potential, we must provide a medium that can be mastered by a single individual. Any barrier that exists between the user and some part of the system will eventually be a barrier to creative expression. Any part of the system that cannot be changed or that is not sufficiently general is a likely source of impediment. If one part of the system works differently from all the rest, that part will require additional effort to control. Such an added burden may detract from the final result and will inhibit future endeavors in that area. We can thus infer a general principle of design:

Good Design: *A system should be built with a minimum set of unchangeable parts; those parts should be as general as possible; and all parts of the system should be held in a uniform framework.*

Language

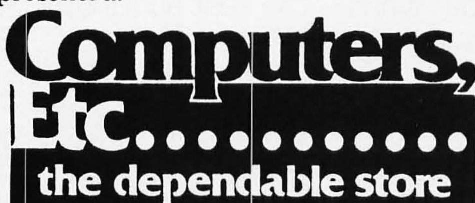
In designing a language for use with computers, we do not have to look far to find helpful hints.

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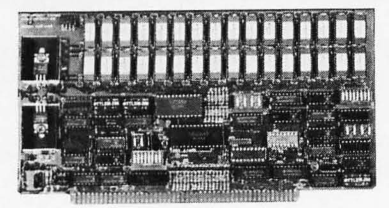


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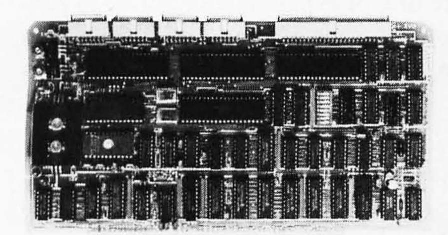
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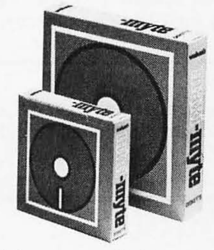
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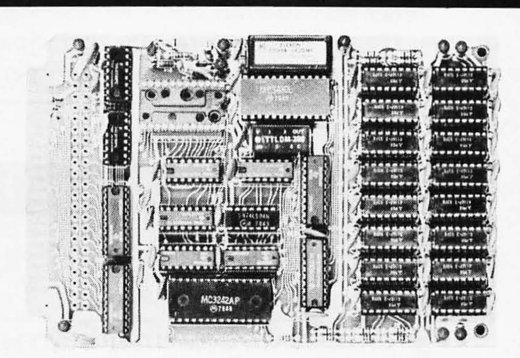
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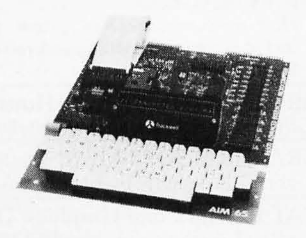


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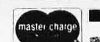
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Everything we know about how people think and communicate is applicable. The mechanisms of human thought and communication have been engineered for millions of years, and we should respect them as being of sound design. Moreover, since we must work with this design for the next million years, it will save time if we make our computer models compatible with the mind, rather than the other way around.

Figure 1 illustrates the principal components in our discussion. A person is presented as having a body and a mind. The body is the site of primary experience, and, in the context of this discussion, it is the physical channel through which the universe is perceived and through which intentions are carried out. Experience is recorded and processed in the mind. Creative thought (without going into its mechanism) can be viewed as the spontaneous appearance of information in the mind. Language is the key to that information:

Purpose of Language: *To provide a framework for communication.*

The interaction between two individuals is represented in figure 1 as two arcs. The solid arc represents explicit communication: the actual words and movements uttered and perceived. The dashed arc represents implicit communication: the shared culture and experience that form the context of the explicit communication. In human interaction, much of the actual communication is achieved through reference to the shared context, and human language is built around such allusion. This is the case with computers as well.

It is no coincidence that a computer can be viewed as one of the participants in figure 1. In this case, the "body" provides for visual display of information and for sensing input from a human user. The "mind" of a computer includes the internal memory and processing elements and their contents. Figure 1 shows that several different issues are involved in the design of a computer language:

Scope: *The design of a language for using computers must deal with internal models, external media, and the interaction between these in both the human and the computer.*

This fact is responsible for the difficulty of explaining Smalltalk to people who view computer languages in a more restricted sense. Smalltalk is

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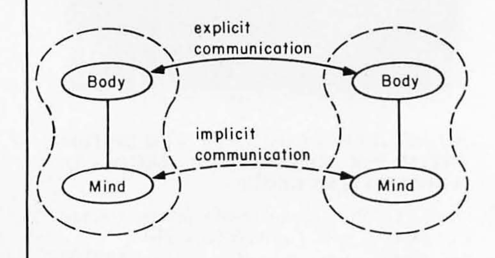


Figure 1: *The scope of language design. Communication between two people (or between one person and a computer) includes communication on two levels. Explicit communication includes the information that is transmitted in a given message. Implicit communication includes the relevant assumptions common to the two beings.*

not simply a better way of organizing procedures or a different technique for storage management. It is not just an extensible hierarchy of data types, or a graphical user interface. It is all of these things and anything else that is needed to support the interactions shown in figure 1.

Communicating Objects

The mind observes a vast universe of experience, both immediate and recorded. One can derive a sense of oneness with the universe simply by letting this experience be, just as it is. However, if one wishes to participate, literally to *take a part*, in the universe, one must draw distinctions. In so doing one identifies an object in the universe, and simultaneously all the rest becomes not-that-object. Distinction by itself is a start, but the process of distinguishing does not get any easier. Every time you want to talk about "that chair over there," you have to repeat the entire process of distinguishing that chair. This is where the act of reference comes in: we can associate a unique identifier with an object, and, from that time on, only the mention of that identifier is necessary to refer to the original object.

We have said that a computer system should provide models that are compatible with those in the mind. Therefore:

Objects: *A computer language should support the concept of "object" and provide a uniform means for referring to the objects in its universe.*

The Smalltalk storage manager provides an object-oriented model of memory for the entire system. Uniform reference is achieved simply by associating a unique integer with every object in the system. This uniformity is important because it means that variables in the system can take on widely differing values and yet can be implemented as simple memory cells. Objects are created when expressions are evaluated, and they can then be passed around by uniform reference, so that no provision for their storage is necessary in the procedures that manipulate them. When all references to an object have disappeared from the system, the object itself vanishes, and its storage is reclaimed. Such behavior is essential to full support of the object metaphor:

Storage Management: *To be truly "object-oriented," a computer system must provide automatic storage management.*

A way to find out if a language is working well is to see if the programs look like they are doing what they are doing. If they are sprinkled with statements that relate to the management of storage, then their internal model is not well matched to that of humans. Can you imagine having to prepare someone for each thing you tell them or having to inform them when you are through with a given topic and that it can be forgotten?

Each object in our universe has a life of its own. Similarly, the brain

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provides for independent processing along with the storage of each mental object. This suggests a third principle for object-oriented design:

Messages: *Computing should be viewed as an intrinsic capability of objects that can be uniformly invoked by sending messages.*

Just as programs get messy if object storage is dealt with explicitly, control in the system becomes complicated if processing is performed extrinsically. Let us consider the process of adding 5 to a number. In most computer systems, the compiler figures out what kind of number it is and generates code to add 5 to it. This is not good enough for an object-oriented system because the exact kind of number cannot be determined by the compiler (more on this later). A possible solution is to call a general addition routine that examines the type of the arguments to determine the appropriate action. This is not a good approach because it means that this *critical* routine must be edited by novices who just want to experiment with their own class of numbers. It is also a poor design because intimate knowledge about the internals of objects is sprinkled throughout the system.

Smalltalk provides a much cleaner solution: it sends the *name* of the desired operation, along with any arguments, as a *message* to the number, with the understanding that the receiver knows best how to carry out the desired operation. Instead of a bit-grinding processor raping and plundering data structures, we have a universe of well-behaved objects that courteously ask each other to carry out their various desires. The transmission of messages is the only process that is carried on outside of objects and this is as it should be, since messages travel between objects. The principle of good design can be restated for languages:

Uniform Metaphor: *A language should be designed around a powerful metaphor that can be uniformly applied in all areas.*

Examples of success in this area include LISP, which is built on the model of linked structures; APL, which is built on the model of arrays; and Smalltalk, which is built on the model of communicating objects. In each case, large applications are viewed in the same way as the fundamental units from which the system is built. In Smalltalk especially, the interaction between the most primitive objects is viewed in the same way as the highest-level interaction between the computer and its user. Every object in Smalltalk, even a lowly integer, has a set of messages, a *protocol,* that defines the explicit communication to which that object can respond. Internally, objects may have local storage and access to other shared information which comprise the implicit context of all communication. For instance, the message + 5 (add five) carries an implicit assumption that the augend is the present

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value of the number receiving the message.

Organization

A uniform metaphor provides a framework in which complex systems can be built. Several related organizational principles contribute to the successful management of complexity. To begin with:

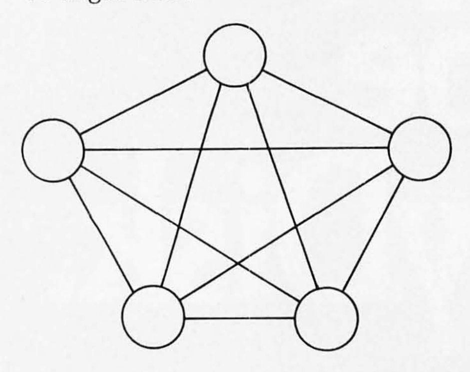


Figure 2: *System complexity. As the number of components in a system increases, the chances for unwanted interaction increase rapidly. Because of this, a computer language should be designed to minimize the possibilities of such interdependence.*

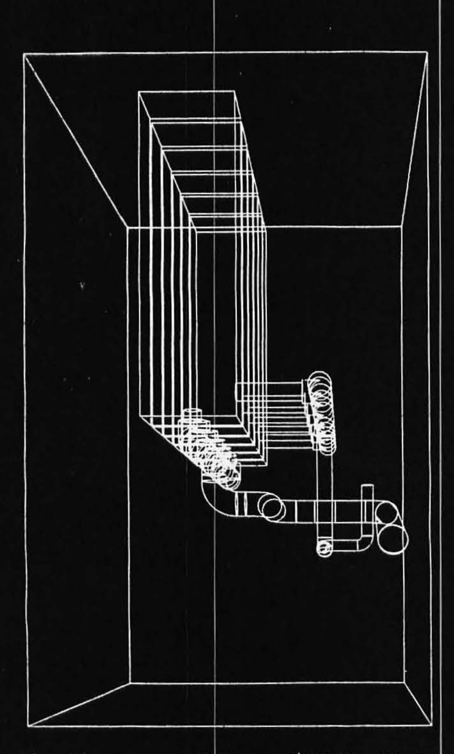
Modularity: *No component in a complex system should depend on the internal details of any other component.*

This principle is depicted in figure 2. If there are *N* components in a system, then there are roughly *N-squared* potential dependencies between them. If computer systems are ever to be of assistance in complex human tasks, they must be designed to minimize such interdependence. The message-sending metaphor provides modularity by decoupling the *intent* of a message (embodied in its name) from the *method* used by the recipient to carry out the intent. Structural information is similarly protected because all access to the internal state of an object is through this same message interface.

The complexity of a system can often be reduced by grouping similar components. Such grouping is achieved through data typing in conventional programming languages, and through *classes* in Smalltalk. A class describes other objects—their internal state, the message protocol they recognize, and the internal methods for responding to those messages. The objects so described are called *instances* of that class. Even classes themselves fit into this framework; they are just instances of class Class, which describes the appropriate protocol and implementation for object description:

Classification: *A language must provide a means for classifying similar objects, and for adding new classes of objects on equal footing with the kernel classes of the system.*

Classification is the objectification of *ness*ness. In other words, when a human sees a chair, the experience is taken both literally as "that very thing" and abstractly as "that chair-like thing." Such abstraction results from the marvelous ability of the mind to merge "similar" experience, and this abstraction manifests itself as another object in the mind, the Platonic chair or chair*ness*.



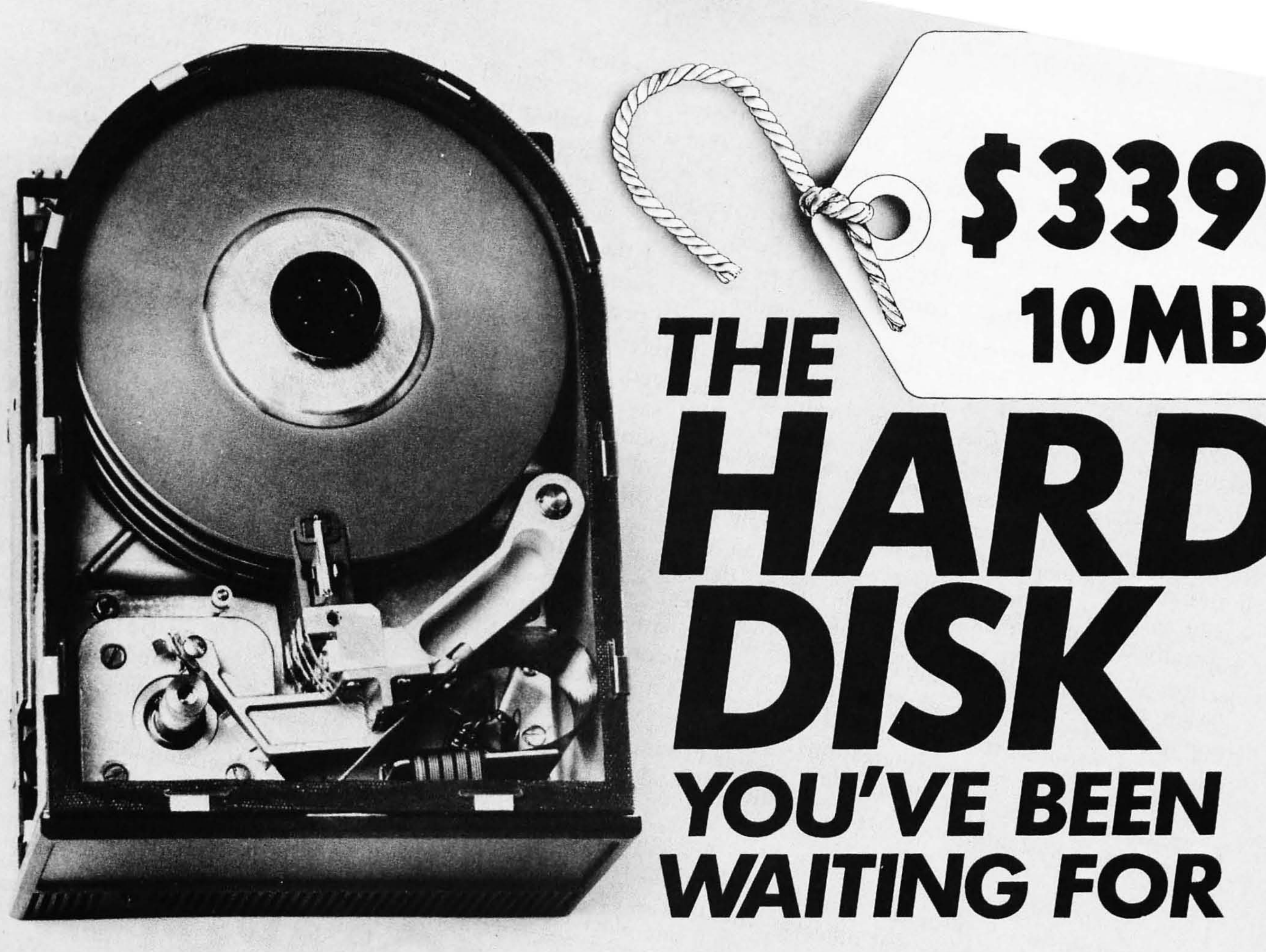
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Classes are the chief mechanism for extension in Smalltalk. For instance, a music system would be created by adding new classes that describe the representation and interaction protocol of Note, Melody, Score, Timbre, Player, and so on. The "equal footing" clause of the above principle is important because it insures that the system will be used as it was designed. In other words, a melody could be represented as an ad hoc collection of Integers representing pitch, duration, and other parameters, but if the language can handle Notes as easily as Integers, then the user will naturally describe a melody as a collection of Notes. At each stage of design, a human will naturally choose the most effective representation if the system provides for it. The principle of modularity has an interesting implication for the procedural components in a system:

Polymorphism: *A program should specify only the behavior of objects, not their representation.*

A conventional statement of this principle is that a program should never declare that a given object is a SmallInteger or a LargeInteger, but only that it responds to integer protocol. Such generic description is crucial to models of the real world.

Consider an automobile traffic simulation. Many procedures in such a system will refer to the various vehicles involved. Suppose one wished to add, say, a street sweeper. Substantial amounts of computation (in the form of recompiling) and possible errors would be involved in making this simple extension if the code depended on the objects it manipulates. The message interface establishes an ideal framework for such extension. Provided that street sweepers support the same protocol as all other vehicles, no changes are needed to include them in the simulation:

Factoring: *Each independent component in a system should appear in only one place.*

There are many reasons for this principle. First of all, it saves time, effort, and space if additions to the system need only be made in one place. Second, users can more easily locate a component that satisfies a given need. Third, in the absence of proper factoring, problems arise in synchronizing changes and ensuring that all interdependent components are consistent. You can see that a failure in factoring amounts to a violation of modularity.

Smalltalk encourages well-factored designs through *inheritance*. Every class inherits behavior from its superclass. This inheritance extends through increasingly general classes, ultimately ending with class Object which describes the default behavior of all objects in the system. In our traffic simulation above, StreetSweeper (and all other vehicle classes) would be described as a subclass of a general Vehicle class, thus inheriting appropriate default behavior and avoiding repetition of the same concepts in many different places. Inheritance illustrates a fur-

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ther pragmatic benefit of factoring:

Leverage: *When a system is well factored, great leverage is available to users and implementers alike.*

Take the case of sorting an ordered collection of objects. In Smalltalk, the user would define a message called sort in the class OrderedCollection. When this has been done, all forms of ordered collections in the system will instantly acquire this new capability through inheritance. As an aside, it is worth noting that the same method can alphabetize text as well as sort numbers, since comparison protocol is recognized by the classes which support both text and numbers.

The benefits of structure for implementers are obvious. To begin with, there will be fewer primitives to implement. For instance, all graphics in Smalltalk are performed with a single primitive operation. With only one task to do, an implementer can bestow loving attention on every instruction, knowing that each small improvement in efficiency will be amplified throughout the system. It is natural to ask what set of primitive operations would be sufficient to support an entire computing system. The answer to this question is called a *virtual machine* specification:

Virtual Machine: *A virtual machine specification establishes a framework for the application of technology.*

The Smalltalk virtual machine establishes an object-oriented model for storage, a message-oriented model for processing, and a bitmap model for visual display of information. Through the use of microcode, and ultimately hardware, system performance can be improved dramatically without any compromise to the other virtues of the system.

User Interface

A user interface is simply a language in which most of the communication is visual. Because visual presentation overlaps heavily with established human culture, esthetics plays a very important role in this area. Since all capability of a computer system is ultimately delivered through the user interface, flexibility is also essential here. An enabling condition for adequate flexibility of a user interface can be stated as an object-oriented principle:

Reactive Principle: *Every component accessible to the user should be able to present itself in a meaningful way for observation and manipulation.*

This criterion is well supported by the model of communicating objects. By definition, each object provides an appropriate message protocol for interaction. This protocol is essentially a microlanguage particular to just that kind of object. At the level of the user interface, the appropriate language for each object on the screen is presented visually (as text, menus, pictures) and sensed through keyboard activity and the use of a pointing device.

It should be noted that operating systems seem to violate this principle. Here the programmer has to depart





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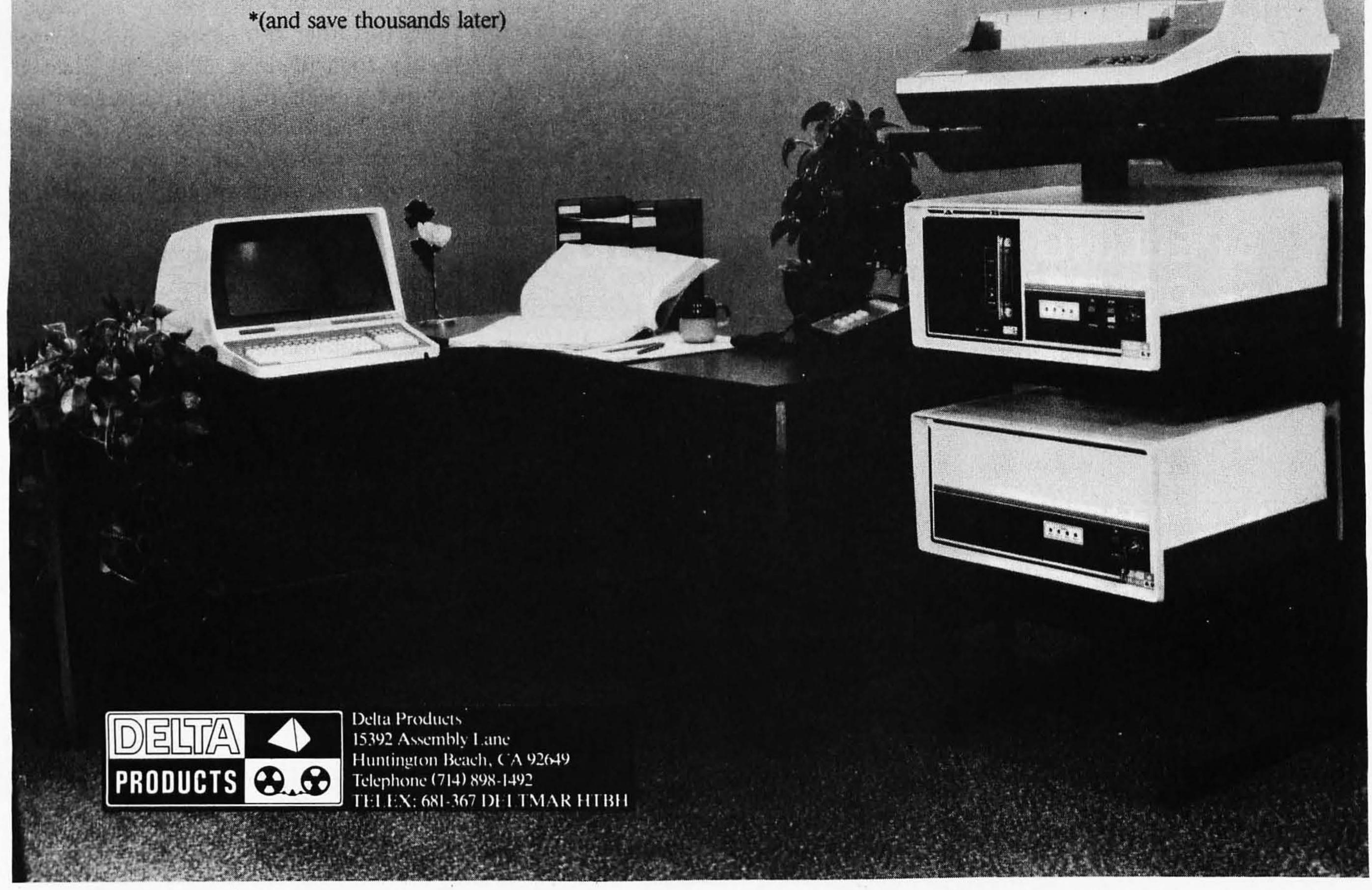
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from an otherwise consistent framework of description, leave whatever context has been built up, and deal with an entirely different and usually very primitive environment. This need not be so:

Operating System: *An operating system is a collection of things that don't fit into a language. There shouldn't be one.*

Here are some examples of conventional operating system components that have been naturally incorporated into the Smalltalk language:

- Storage management—Entirely automatic. Objects are created by a message to their class and reclaimed when no further references to them exist. Expansion of the address space through virtual memory is similarly transparent.
- File system—Included in the normal framework through objects such as Files and Directories with message protocols that support file access.
- Display handling—The display is simply an instance of class Form, which is continually visible, and the graphical manipulation messages defined in that class are used to change the visible image.
- Keyboard input—The user input devices are similarly modeled as objects with appropriate messages for determining their state or reading their history as a sequence of events.
- Access to subsystems—Subsystems are naturally incorporated as independent objects within Smalltalk: there they can draw on the large existing universe of description, and those that involve interaction with the user can participate as components in the user interface.
- Debugger—The state of the Smalltalk processor is accessible as an instance of class Process that owns a chain of stack frames. The debugger is just a Smalltalk subsystem that has access to manipulate the state of a suspended process. It should be noted that nearly the only run-time error that can occur in Smalltalk is for a message not to be recognized by its receiver.

Smalltalk has no "operating system" as such. The necessary primitive operations, such as reading a page from the disk, are incorporated as primitive methods in response to otherwise normal Smalltalk messages.

Future Work

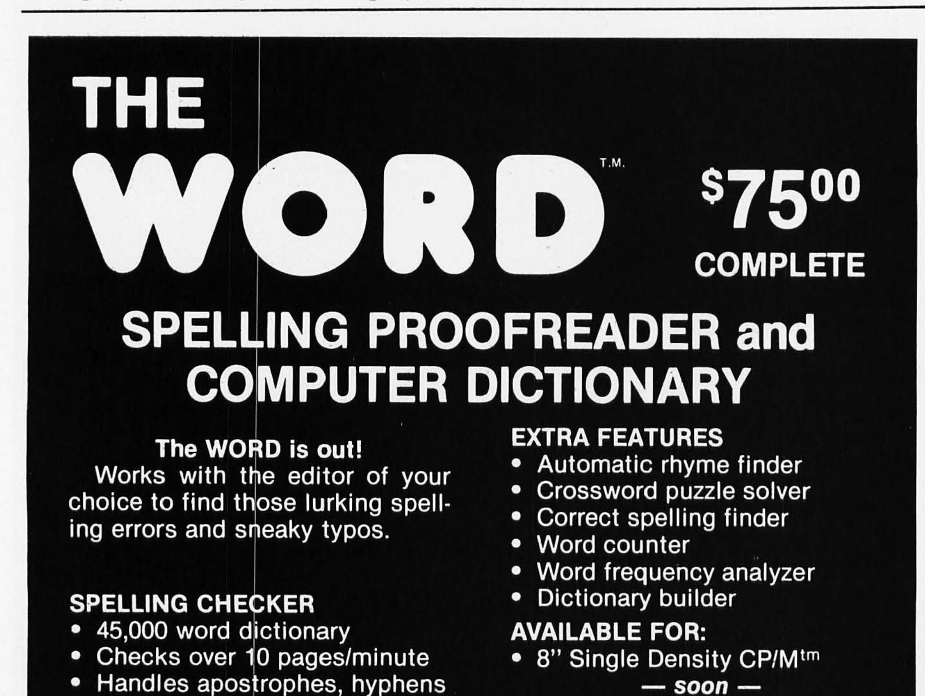
As might be expected, work remains to be done on Smalltalk. The easiest part to describe is the continued application of the principles in this paper. For example, the Smalltalk-80 system falls short in its factoring because it supports only hierarchical inheritance. Future Smalltalk systems will generalize this model to arbitrary (multiple) inheritance. Also, message protocols have not been formalized. The organization provides for protocols, but it is currently only a matter of style for protocols to be consistent from one class to another. This can be remedied easily by providing proper protocol objects that can be consistently shared. This will then allow formal typing of variables by protocol without losing the advantages of polymorphism.

The other remaining work is less easy to articulate. There are clearly other aspects to human thought that have not been addressed in this paper. These must be identified as metaphors that can complement the existing models of the language.

Sometimes the advance of computer systems seems depressingly slow. We forget that steam engines were high-tech to our grandparents. I am optimistic about the situation. Computer systems are, in fact, getting simpler and, as a result, more usable. I would like to close with a general principle which governs this process:

Natural Selection: *Languages and systems that are of sound design will persist, to be supplanted only by better ones.*

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The Smalltalk-80 Virtual Machine

Glenn Krasner
Learning Research Group
Xerox Palo Alto Research Center
3333 Coyote Hill Rd
Palo Alto CA 94304

The Smalltalk-80 system is a powerful system that encourages the development of large applications programs. The system contains a compiler, a debugger, a storage management system, text and picture editors, and a file system. It also contains a highly interactive user interface based on graphics that include overlapping windows.

Typically the task of bringing up such a powerful system on a new computer includes writing code to implement these pieces. The Smalltalk-80 system is different in that most of these pieces are written in Smalltalk-80 itself. The part that can be written in Smalltalk-80 is called the *Smalltalk-80 Virtual Image*, and it includes the compiler, debugger, editors, decompiler, and the file system.

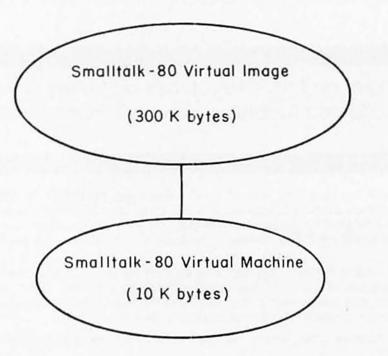


Figure 1: *The Smalltalk-80 Virtual Machine. Most of Smalltalk-80 is written in Smalltalk-80 (the Virtual Image), leaving only a small amount of code that has to be rewritten for each processor on which the language is implemented (the Virtual Machine).*

The remaining part of the Smalltalk-80 system is defined in terms of an abstract machine called the *Smalltalk-80 Virtual Machine* (see figure 1). The Smalltalk-80 compiler translates source code into machine instructions for this virtual machine, rather than translating directly into machine instructions for a particular hardware machine. The task of bringing up a Smalltalk-80 system on a new "target" computer consists only of implementing (writing a program to simulate) the Smalltalk Virtual Machine on the target computer.

In this article, we will present an overview of the elements needed to implement the Smalltalk Virtual Machine. These elements are:

- the *Storage Manager*
- the *Interpreter*
- the *Primitive Subroutines*

Background

A Smalltalk-80 system is made up of *objects* that have state and exhibit behavior. Their state consists of the values of both named and indexed instance variables (which we will call *fields*), and their behavior is exhibited through sending and receiving *messages*. Objects are members of *classes*.

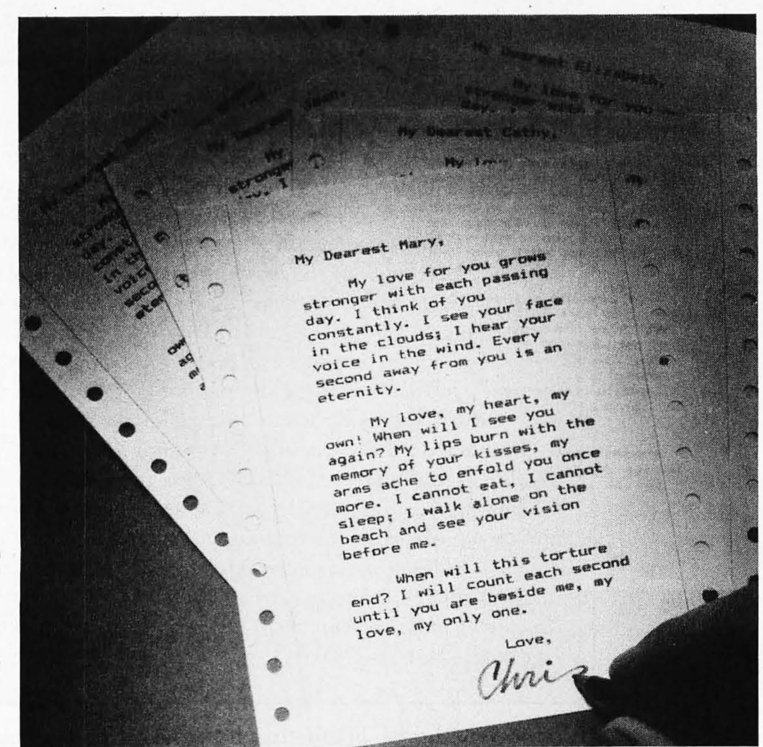
Classes may be *subclasses* of other classes—that is, they may inherit attributes from other classes. Programming in Smalltalk-80 is done by defining the procedures, or *methods*, that are executed when objects receive messages. Typically, messages are sent to other objects to invoke their methods. Sometimes messages invoke *primitive* (machine-code) *subroutines* rather than Smalltalk-80 methods.

From this brief description of Smalltalk-80, we can consider the information needed to implement each of the three elements of the Smalltalk Virtual Machine:

1. To implement the storage manager, we need the information necessary to represent objects in the computer's memory. This information consists of the amount of memory that each object will occupy, which can be computed from the number of fields the object has, and the representation of fields in memory. Objects that describe classes define the number of fields their instances will have, so we also need to know how this number is represented. With this information, we can design a storage manager for objects in a Smalltalk-80 system that will:

- fetch the class of objects
- fetch and store fields of objects
- create new objects
- collect and manage free space

2. The interpreter executes the machine instructions of the Smalltalk-80 Virtual Machine. The information needed to design the interpreter is a description of these machine instructions, called bytecodes (the idea is similar to Pascal p-codes). The bytecodes are contained in methods, so we also need to know the representa-



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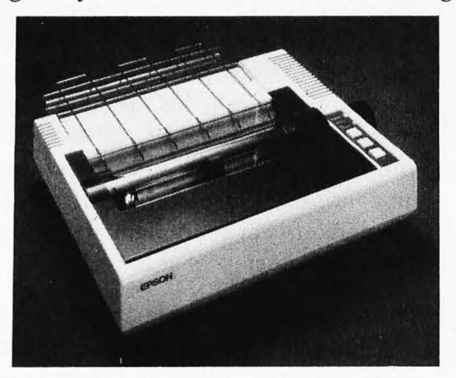
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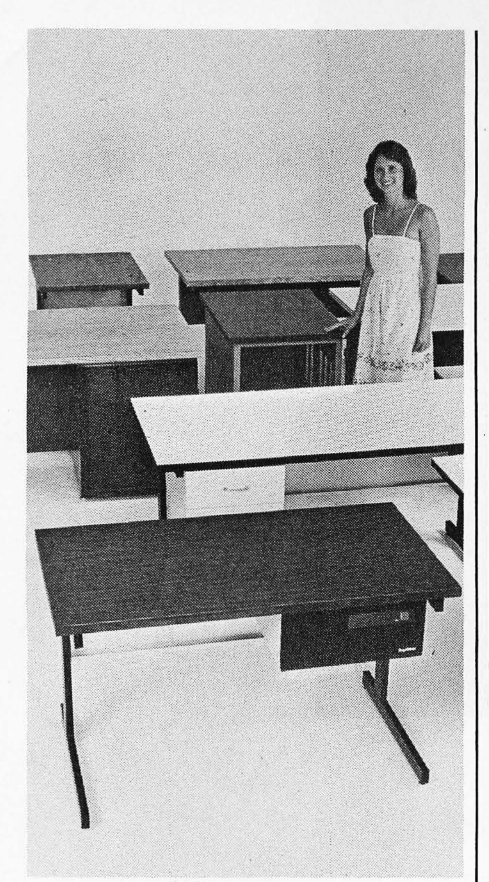
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Who's Who

The design of the Smalltalk-80 Virtual Machine is based on previous Smalltalk systems implemented by the Learning Research Group at Xerox PARC. The original bytecode interpreter design was made for Smalltalk-76 by Dan Ingalls (Ingalls, Dan. "The Smalltalk-76 Programming System: Design and Implementation." In Fifth Annual ACM Symposium on Principles of Programming Languages, *1978, pages 9 through 16). Smalltalk-76 was implemented on the Xerox Alto by Dan Ingalls, Ted Kaehler, Dave Robson, Steve Weyer and Diana Merry, on the Xerox Dolphin by Peter Deutsch, and on the Xerox Dorado by Bruce Horn. TinyTalk was implemented on a Xerox microcomputer by Larry Tesler and Kim McCall (McCall, Kim and Larry Tesler. "Tiny Talk, a Subset of Smalltalk-76 for 64KB Microcomputers." In* Proceedings of the Third Symposium on Small Systems, *ACM Sigsmall Newsletter, Volume 6, Number 2, 1980, pages 197 through 198). Smalltalk-78 (a revised version of Smalltalk-76 similar to Smalltalk-80) was implemented on the Xerox microcomputer by Dan Ingalls, Ted Kaehler, and Bruce Horn, on the Xerox Dorado by Jim Stamos, and on a Norwegian microcomputer (under a research license from Xerox) by Bruce Horn. Smalltalk-80 has been implemented on the Xerox Dorado by Peter Deutsch, on the Xerox Dolphin by Kim McCall, and on the Xerox Alto by Glenn Krasner. The designs of these systems were made by the implementors and other members of the Learning Research Group.*

tion of methods. From this information we can decide how the interpreter will fetch and execute bytecodes and how it will find methods to run when messages are sent.

3. The last piece of information we need to know is which messages will invoke primitive subroutines; that is, which methods we must implement in machine code to terminate the recursion of message sending and to optimize performance.

Before we go into more detail about these elements of a Smalltalk-80 Virtual Machine implementation, here are a few typical figures that will provide a little "reality" to implementors. For the systems that we have implemented at Xerox, the Smalltalk-80 Virtual Image consists of about 300 K bytes of objects. Our typical implementation of the Smalltalk-80 Virtual Machine is 6 to 12 K bytes of assembly code, or 2 K microcode instructions plus 10 K bytes of assembly code. Of this, about 40% is in the storage manager, 20% in the interpreter, and 40% in the primitive subroutines. Our average is about one person-year to implement a fully debugged version of this code.

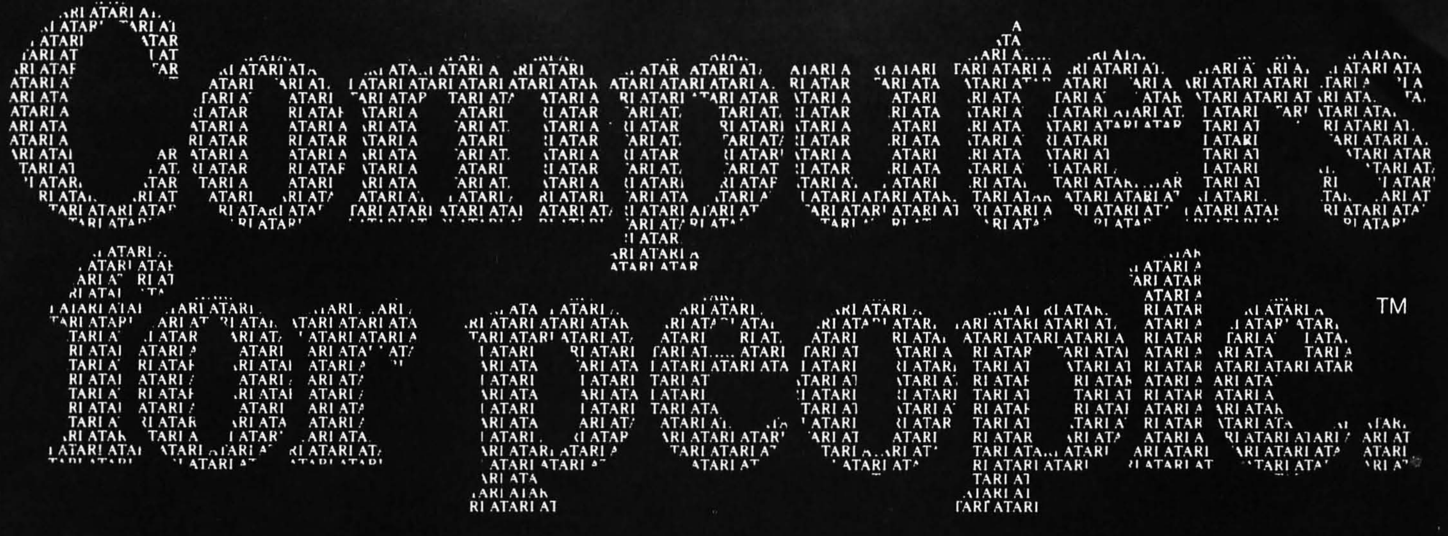
The Storage Manager

Although the storage manager tends to be the largest and most complex of the three parts of a Smalltalk-80 implementation, the functions it provides are few and relatively simple to understand.

Everything in a Smalltalk-80 system is an object.

Everything in a Smalltalk system is an object, so from a storage point of view memory needs to be divided into blocks, one for each object, plus a pool of memory that is not yet used. Every time a new object is created, a new block of the appropriate size must be found for that object: when objects are no longer used, their memory block may be returned to the pool (see figure 2).

A special entity called an *object pointer* is assigned to each object. If an object pointer were the actual core address of the memory occupied by that object, then there would be fast access to an object given its pointer. However, in the Smalltalk-80 system the object pointer is an *indirect* pointer to the object through a table kept by the storage manager. This allows the storage manager to move an object around in memory without affecting any object that refers to it. It also insures that the storage manager is the only entity in the system concerned with (and allowed to change)





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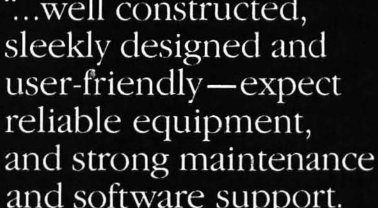
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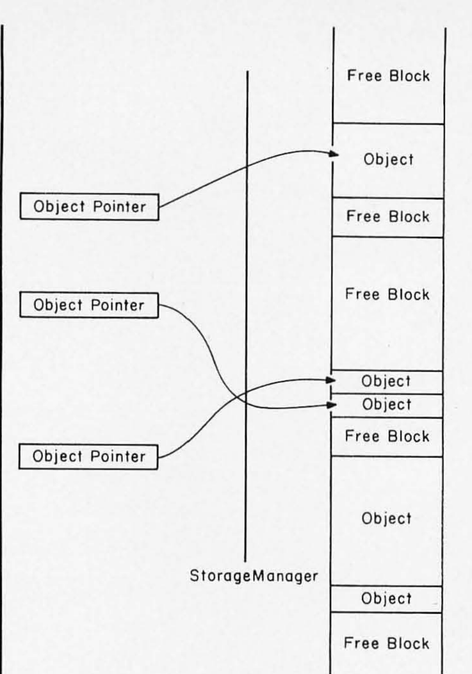
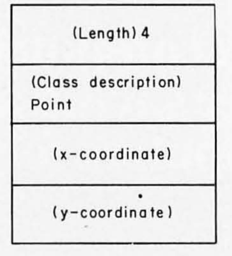


Figure 2: *Objects and memory usage in Smalltalk-80. Each Smalltalk-80 object has an object pointer that points to a block of memory that describes the object. When an object is no longer used, its memory is made available for use.*



(Length) 5
(Class description) Triangle
(First vertex)
(Second vertex)
(Third vertex)

(Length) 4	
(Class description) ByteArray	
1	2
3	4

Figure 3: *Typical object representations in Smalltalk-80.*

the actual memory. In the Smalltalk-80 Virtual Image, object pointers are single 16-bit words. This allows for 64 K objects in the system; these objects may take up much more than 64 K words of memory.

Since an object's class and fields are themselves objects, we can see that the block of memory corresponding to an object contains the object pointer of the object's class plus the object pointer for each of the object's fields. The storage manager also keeps the length of the block as one word of the block. This means, for example, that the block corresponding to an object that is an instance of class Point (see figure 3) will have:

- one word that says this block is four words long
- one word that is the object pointer of the object that describes class Point
- one word that is the object pointer of an object that is the *x*-coordinate field of the point
- one word that is the object pointer of an object that is the *y*-coordinate field of the point

Similarly, the block corresponding to an object that is an instance of class Triangle will have:

- one word saying this block is five words long
- one word that is the object pointer of the object that describes class Triangle
- one word that is the object pointer of an instance of class Point, representing one vertex field
- one word that is the object pointer of an instance of class Point, for the second vertex field
- one word that is the object pointer of an instance of class Point, for the third vertex field

For performance optimization, the values in the fields of some objects, such as instances of class ByteArray, will be interpreted as the numerical values themselves, rather than as object pointers. The block corresponding to the byte array containing the elements 1, 2, 3, and 4, in order, will have:

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- one word saying this block is four words long
- one word pointing to the object that describes class ByteArray
- one byte encoding the number 1
- one byte encoding the number 2
- one byte encoding the number 3
- one byte encoding the number 4

We will represent all objects as having fields interpreted as object pointers or numerical values, not both. Objects may store numerical values as bytes or words, but not both.

As we have mentioned, the objects that describe classes also need to represent the form of instances of those classes. The essential information is the number of fields the instances will have, and whether these will be pointer or nonpointer fields. For example, the describer of class Point says that its instances will have two fields (*x*- and *y*-coordinates) and that these will be pointers (see figure 4). The describer of class ByteArray says that its instances may have a variable number of fields and that these fields will not be pointers but will be numerical values stored in bytes.

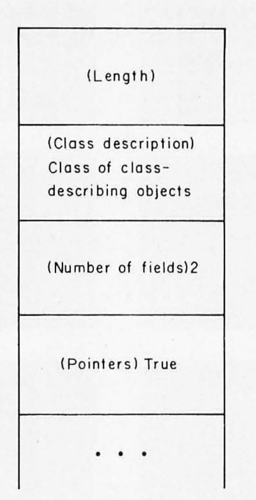


Figure 4: *Class-describing object for class* Point.

The purpose of the storage manager is to fetch and store fields of objects, to create objects, and to manage free space. A clean implementation of the storage manager would be one in which the other parts of the system had access only to the object pointers and made requests of the storage manager only through the following subroutine calls:

- getClass(objectPointer) returns the object pointer of the class of the given object
- getField(objectPointer,fieldOffset) returns the field
- storeField(objectPointer,fieldOffset,newValue) replaces that field with the new value newValue
- newInstance(classObjectPointer,numberOfFields) returns the object pointer of a new instance of that class, and, if that class can have indexed instance variables, this instance has the given number of fields (numberOfFields)

Requests can be made for new storage (with the newInstance subroutine), but not to return used storage. In some other systems, storage that is no longer used must be explicitly returned to the free storage pool. The Smalltalk-80 philosophy is that neither the user nor any part of the system other than the storage manager need have such concerns. Therefore the storage manager must know which objects are no longer being used, so that their storage may reenter the free pool. Typically, Smalltalk-80 Virtual Machine implementations use *reference-counting* to accomplish this. For every object in the system, the storage manager keeps a count of the number of other objects that point to it. This number will change only during execution of the four storage-manager subroutines. When this count reaches zero, the object's memory block may be reused because there are no references to that object anywhere else in the system.

The Interpreter

The interpreter is that portion of the Smalltalk-80 Virtual Machine that performs the actions described in the bytecodes of methods (ie: the machine code of the Virtual Machine). The information needed to implement the interpreter is the

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description of the bytecodes, the representation of methods, and the technique to find the method to run when sending a message.

The bytecodes define the Smalltalk-80 Virtual Machine as a stack-oriented machine. Each bytecode represents one of the following actions:

- push an object onto the stack
- store the top of the stack as the value for a variable
- pop the top of the stack
- branch to another bytecode
- send a message using the top few elements of the stack
- return the top of the stack as the value for this method

In the Smalltalk-80 Virtual Machine, each of these actions is realized by one or more bytecodes. Note that pushing, storing, popping, and branching are standard instruction types for any stack machine, that sending a message corresponds to calling a procedure using the top few elements of the stack as arguments, and that returning an object from a method corresponds to returning a value from a procedure. The difference between the Smalltalk-80 Virtual Machine and procedure-based stack machines is in the way the procedure is found. In most procedure-based stack machines the address of a procedure is provided in the *execute procedure* instruction; in the Smalltalk-80 system only the "name," called the *selector*, of the message is provided; the method (or procedure) to be executed is found through a strategy involving the receiver of the message and its class. We will first describe the bytecodes, then how methods are represented, and finally give a strategy for finding methods.

Bytecode	Stack Contents After Execution (Top of Stack to Right)
-1- Push 3	(3)
-2- Push 4	(3 4)
-3- Push 5	(3 4 5)
-4- Send +	(3 9)
-5- Send *	(27)

Table 1: *Bytecodes for the Smalltalk expression* 3 * (4 + 5).

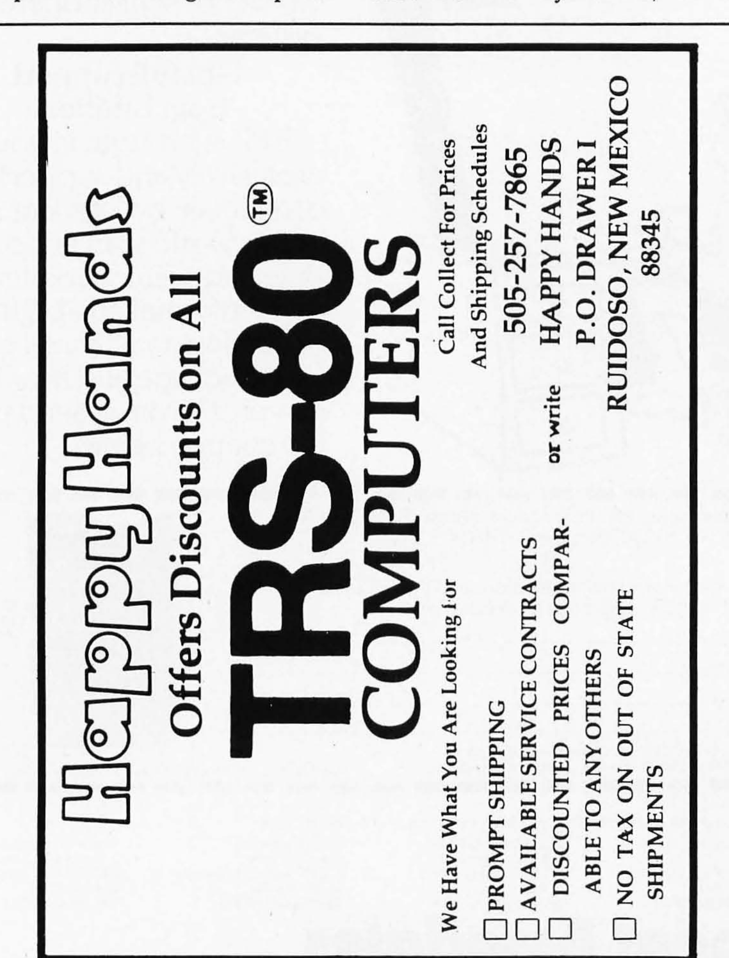
Stack Operations

The Smalltalk-80 Virtual Machine and corresponding bytecode set are stack oriented. Object pointers are pushed and popped from a stack, and when a message is sent, the top few elements of the stack are used as receiver and arguments of the method. These are replaced by the object returned as the value of that method. For example, the Smalltalk-80 expression:

```
3 * (4 + 5)
```

is encoded by the bytecodes shown in table 1.

As bytecodes labeled -1-, -2-, and -3- are executed by the interpreter, the objects 3, 4, and 5 are pushed onto the stack. When bytecode -4- is executed, the message + is sent to the second object on the stack (4) with the top object of the stack as the argument (5). The 4 and 5 are popped off this stack when the message is sent, and the interpreter begins executing the bytecodes for the method corresponding to the message + in the Smalltalk class of small integers. This method will eventually return an object, in this case 9, as its value, and the interpreter will push the 9 onto the original stack above the 3 and resume execution with bytecode -5-. Bytecode -5- will produce an effect similar to that produced by -4-, leaving the object 27 on the stack. In the same way that other stack machines push *data* onto a *stack* and use the top few data items as *arguments* for a *procedure*, replacing them with the *value* returned from that procedure, the Smalltalk-80 Virtual Machine pushes *object pointers* onto a *stack*



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and uses the top few as *receiver* and *arguments* of a *message*, replacing them with the *object* returned from that method.

In both machines, values from the top of the stack may be stored as the values of variables. As an example, the Smalltalk expression:

a ← 3 + 4

will be represented by the bytecodes in table 2. Here, -1-, -2- and -3- act as before and the interpreter executes bytecode -4- by storing the top of the stack 7 into the variable a.

Stack machines in general, and the Smalltalk-80 Virtual Machine in particular, also have the ability to pop the top element off the stack. In the statements:

a ← 3.
b ← 4

once the 3 is stored into variable a, it is no longer needed, so it is popped from the stack. These statements are represented by the bytecodes shown in table 3.

The top of the stack may be returned as the value for the method. The statements:

a ← 3.
↑ a

are represented by the bytecodes shown in table 4.

Bytecode	Stack Contents After Execution (Top of Stack to Right)
-1- Push 3	(3)
-2- Push 4	(3 4)
-3- Send +	(7)
-4- Store into a	(7)

Table 2: *Bytecodes for the Smalltalk expression* a ← 3 + 4.

Bytecode	Stack Contents After Execution (Top of Stack to Right)
-1- Push 3	(3)
-2- Store into a	(3)
-3- Pop	( )
-4- Push 4	(4)
-5- Store into b	(4)

Table 3: *Bytecodes for the Smalltalk expression* a ← 3. b ← 4.

Bytecode	Stack Contents After Execution (Top of Stack to Right)
-1- Push 3	(3)
-2- Store into a	(3)
-3- Pop	( )
-4- Push a	(3)
-5- Return top of stack	( )

Table 4: *Bytecodes for the Smalltalk expression* a ← 3. ↑ a.

Branching Operations

Conditional and looping messages are used so often that they are represented not by actual messages but by bytecodes for conditional and unconditional jumps. (This is *only* for performance reasons; these branching and looping messages would work if they were actually sent like other messages.) For example:

a > 4 ifTrue: [a ← a − 1]

(which in the Smalltalk-80 system means execute the code within the brackets only if the object returned from the > message is not false) is represented in table 5 (ignoring the stack from now on).

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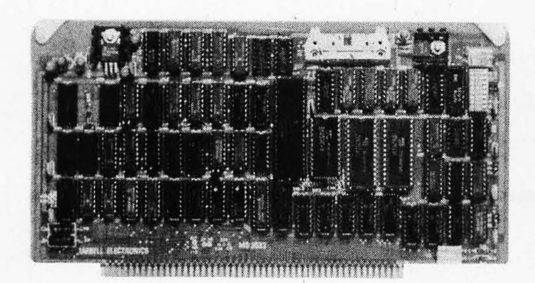
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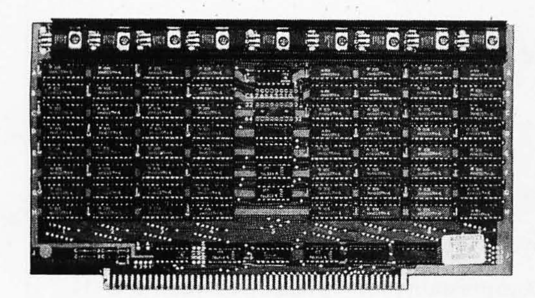
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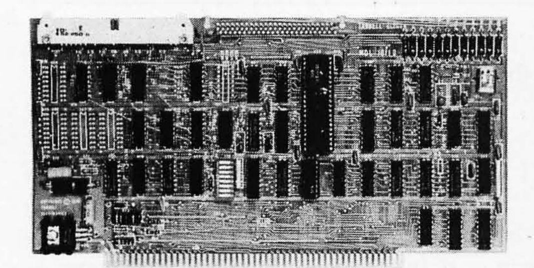
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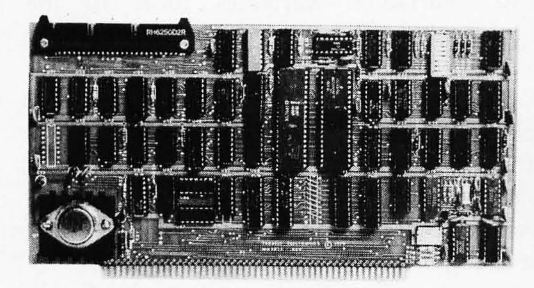
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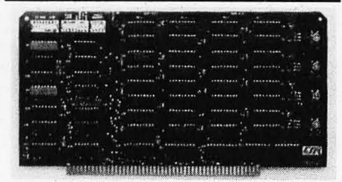
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Bytecode

-1- Push 4
-2- Push a
-3- Send >
-4- Jump to -10- if the top of the stack is false
-5- Push a
-6- Push 1
-7- Send −
-8- Store into a
-9- Pop
-10- < the next bytecode >

Table 5: *Bytecodes for the Smalltalk expression* a > 4 ifTrue: [a ← a − 1].

Bytecode

-1- Push a
-2- Push 4
-3- Send >
-4- Jump to -11- if top of stack is false
-5- Push a
-6- Push 1
-7- Send −
-8- Store into a
-9- Pop
-10- jump to -1-
-11- < the next bytecode >.

Table 6: *Bytecodes for the Smalltalk expression* [a > 4] whileTrue: [a ← a − 1].

Table 6 shows the bytecodes for the looping expression:

[a > 4] whileTrue: [a ← a − 1]

(which means execute the code in the second brackets as long as the code in the first set of brackets evaluates to something other than false).

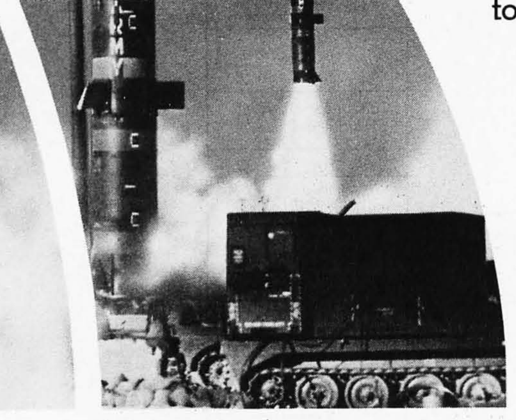
Addressing Variables

Methods are implemented as objects whose fields contain the bytecodes plus a group of pointers to other objects called the *literal frame*. The interpreter can use the getField subroutine of the storage manager to fetch the next required bytecode to execute. This takes care of returns, jumps, and pops, but for the other bytecodes we need to represent more information. In particular, for the push and store bytecodes, we need to represent where to find the object pointers to push; for the send bytecodes, we need to represent where to find the selector of the message and which stack elements are the receiver and arguments.

The source code for a method contains variable names and literals, but the bytecodes of the Virtual Machine are defined only in terms of field offsets. From the Virtual Machine's point of view, there are three types of variables: variables local to the method (called *temporaries*), variables local to the receiver of the message (*instance variables*), or variables found in some dictionary that the receiver's class shares (*global variables*). Note that *class variables* are treated in the same way as other global variables. The Smalltalk-80 compiler (itself written in Smalltalk-80) translates references to these variables into bytecodes that are references to field offsets of the receiver, the temporary area, or globals. The instance variables are translated using a field of class-describing objects that associates instance variable names with field offsets. The assignment of offsets to temporaries is done when the compiler translates a method by associating

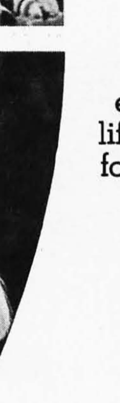
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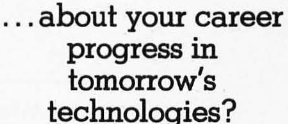


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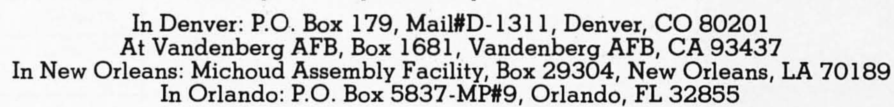
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names of temporaries to offsets in the temporary area. The compiler creates instances for the literals, puts their object pointers into the literal frame of the method, and produces bytecodes in terms of offsets into the literal frame. For global variables, the compiler uses system dictionaries that associate global names to indirect references to objects. Object pointers of the indirect references to the global objects are also placed in the literal frame of the method. The bytecodes for accessing globals are encoded as indirect references through field offsets of the literal frame.

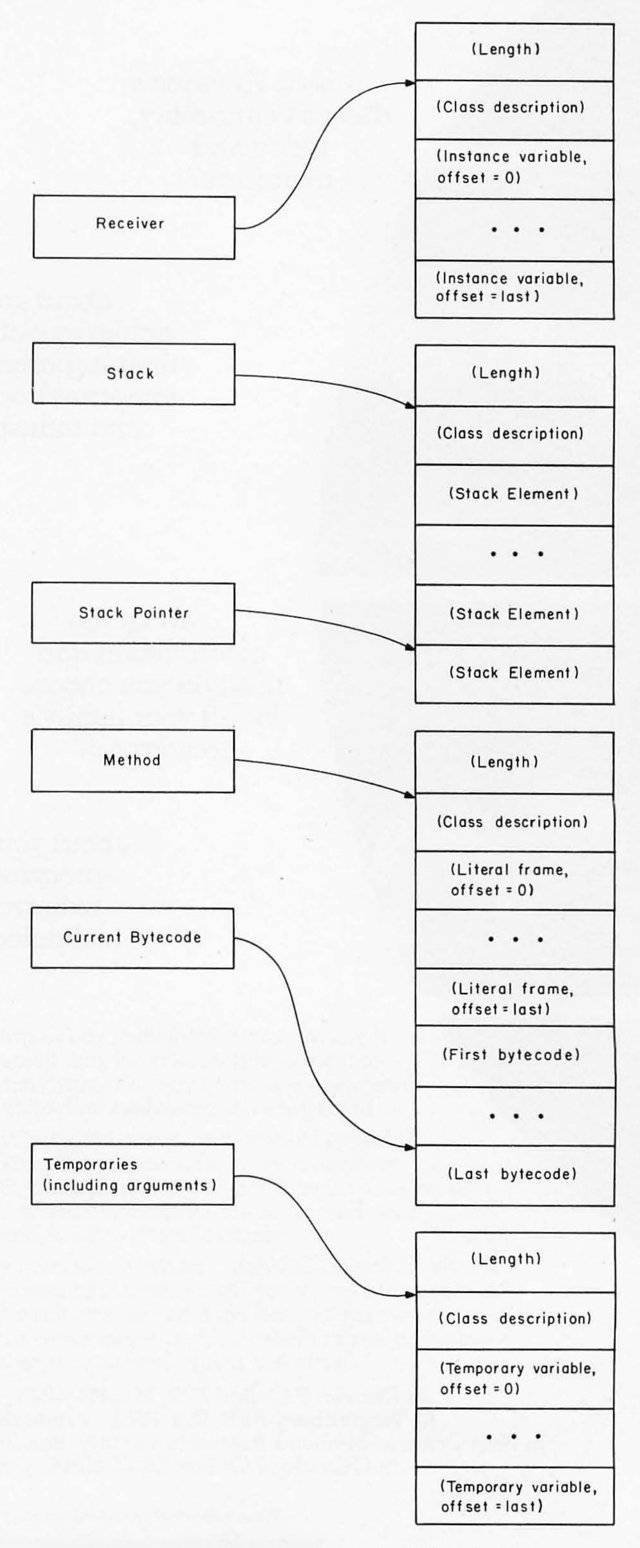


Figure 5: *Object pointers held by the interpreter.*



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This means that when the interpreter is executing a method, it has to keep a stack, a temporary area, a pointer to the receiver and arguments of the method, and a pointer to the method itself (see figure 5). It uses the storage manager's getField and storeField subroutines to push and pop pointers from the stack object, to retrieve and set values of variables in the temporary area, to retrieve and set values of variables of the receiver, and to get bytecodes and values of global variables from the method.

Finding Methods

When a message is sent, the receiver and arguments must be identified, and the appropriate method must be found by the interpreter. The technique used in Smalltalk-80 is to include in each class-describing object a dictionary, called the *method dictionary*, that associates selectors with methods. Pointers to the selectors that will be sent by any method are kept in the method (along with global variable pointers and bytecodes). The bytecodes that tell the interpreter to send a message encode a field offset in the literal frame where the selector is found, plus the number of arguments that that method needs. By convention, the top elements of the stack are the arguments and the next one down is the receiver. For example, the send bytecode for the expression:

```
3 + 4
```

will stand for "send the selector in field X of the method (which will be +), and it takes one argument." The interpreter will ask the storage manager for the X field of the method, will get the top of the stack (4) as the argument, and the next element down (3) as the receiver. It will locate the receiver's class, its method dictionary, search it for an association of the + selector with some method, and, when found, execute that method.

If no such association is found, the searching does not end. The receiver's class may be a subclass of another class, called its *superclass*. If this is the case, the method for + may be

(Length) 7
(Class description) Class of class-describing objects
(Number of fields) 2
(Pointers) True
(Instance Variable Names) "xCoordinate yCoordinate"
(Global Variable Dictionaries)
(Method Dictionary)
(SuperClass)

Figure 6: *Class-describing object for class* Point, *revisited.*

defined in the superclass, so the interpreter must check there. This means that each class must have a field that refers to its superclass (see figure 6). The interpreter searches the method dictionary of the superclass, its superclass, and so on, until either an appropriate method is found or it runs out of superclasses, in which case an error occurs.

To execute a method, the interpreter needs a place for temporaries and a stack for that method. In the Smalltalk-80 Virtual Machine, this is done by allocating an object that is an instance of class MethodContext. Objects in MethodContext keep track of the method, the stack for that method, a pointer to the next bytecode to be executed in that method, the temporary variables for that method, and the context from which that method was invoked, called the *caller* of that method (see figure 7). When a method returns, the value returned is pushed on the stack of the caller context, and execution continues at the next bytecode of the caller's method.

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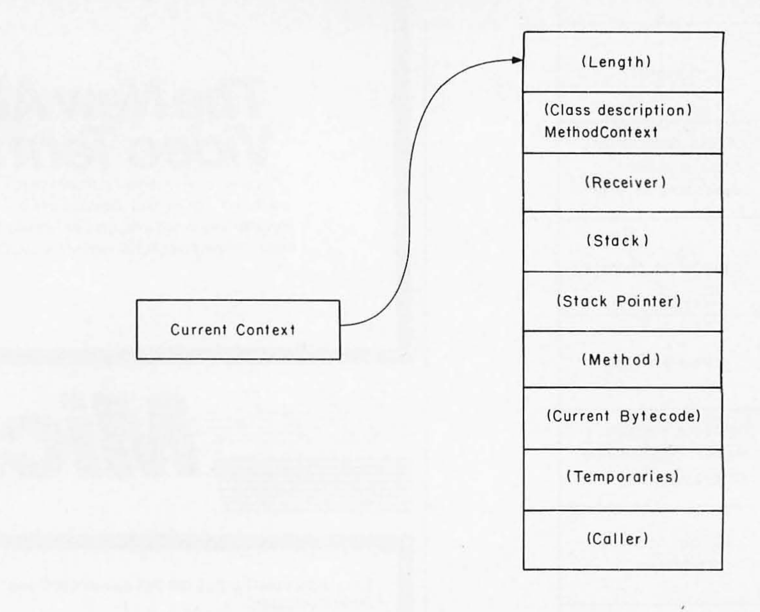


Figure 7: *The only object pointer used by the Smalltalk-80 interpreter is a reference to a* MethodContext.

The Smalltalk-80 Virtual Machine implementation is a program running in the machine language of the target computer.

Primitive Subroutines

The Smalltalk-80 Virtual Machine implementation is a program running in the machine language of the target computer. The storage manager is the collection of subroutines in this program that deals with memory allocation and deallocation. The interpreter is the collection of subroutines in this program, one of which fetches the next bytecode from the currently running method and calls one of the others to perform the appropriate action for that bytecode. In addition to these functions, we have found that there are several other places in the Smalltalk-80 system where performance considerations make it necessary, or at least desirable, to implement certain functions as machine-code subroutines in the Smalltalk-80 Virtual Machine. These places are:

- input/output: connecting the Smalltalk-80 system to the actual hardware
- arithmetic: basic arithmetic for integers
- subscripting indexable objects: fetching and storing indexable instance variables
- screen graphics: drawing and moving areas of the screen bitmap quickly
- object allocation: connecting the Smalltalk-80 code for creating a new instance with the storage manager subroutines

We call this set of subroutines the *primitive subroutines*.

The primitive subroutines are represented in the Smalltalk Virtual Image as methods with a special flag that says to run the corresponding subroutine rather than the Smalltalk-80 bytecodes. When the interpreter is executing the code to send a message and finds one of these flags set, it calls the subroutine and uses the value returned from it as the value of the method. The number of these methods in Smalltalk-80 is small (around one hundred) in order to keep the rest of the system as flexible and extensible as possible. We will not list those methods that are primitives, but will refer the reader to *Smalltalk: the Language and Its Implementation* (Goldberg, Robson, and Ingalls, 1981) for details.



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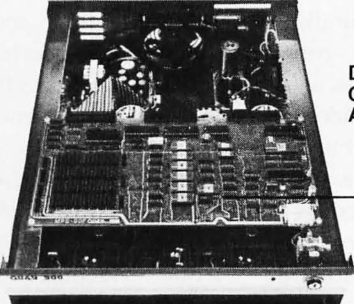
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A few of these primitive methods are executed so often that even the cost of looking them up in their classes' method dictionaries would be excessive. These methods are instead represented as special versions of the Send Message type of bytecodes. The message + , for example, is represented this way. When this bytecode is executed and the top two elements of the stack are small integers, then the primitive method is called as a subroutine. When this bytecode is executed and the top two elements of the stack are not small integers, then the + message is sent normally.

Conclusion

The Smalltalk-80 Virtual Machine is a fairly small computer program that consists of a storage manager, an interpreter, and a set of primitive subroutines. The task of implementing a Smalltalk-80 Virtual Machine for a new target computer is not large (especially when compared with the task of implementing other large programming systems) because most of the functions that must usually be implemented in machine code are already part of the Smalltalk-80 Virtual Image that runs on top of the Virtual Machine.

The Smalltalk-80 Virtual Machine could also be implemented in hardware, although this has not yet been done. Such an implementation would sacrifice some of the flexibility of software, but it would result in the performance benefits that hardware provides. Given the evolving nature of Smalltalk, it may not yet be time to implement the Virtual Machine in hardware: new Smalltalks that are more powerful would likely need at least small changes in Virtual Machine definition and implementation. However, hardware assists to Smalltalk-80 Virtual Machine software can greatly improve performance. Writable microcode stores for the pieces of code that are frequently run, hardware assists for graphics, or hardware assists for the fetching of bytecodes could all potentially improve the performance of a Smalltalk-80 Virtual Machine implementation. ■

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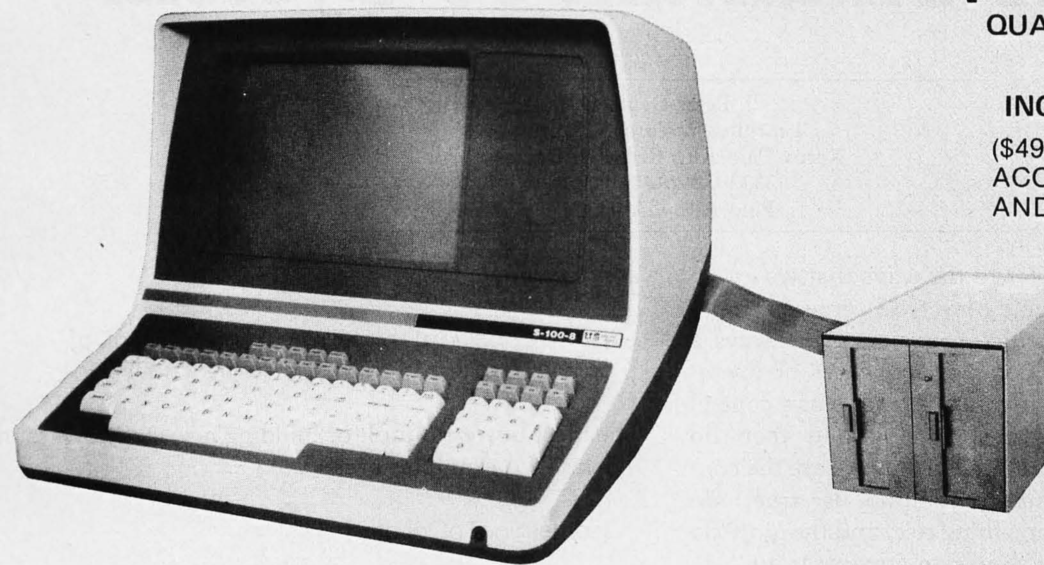
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Building Control Structures in the Smalltalk-80 System

L Peter Deutsch
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Just as *data structures* refer to the ways that we group data together by using simple *objects* to represent more complex objects, *control structures* refer to the ways a programmer can build up complex sequences of *operations* from simpler ones. The easiest example of a control structure is sequencing: do something and then do something else. Two other familiar examples are the *conditional* structure (if some condition is true, do something, otherwise do something else) and the *loop* (do something as long as some condition remains true).

Most languages provide a few common control structures, typically sequencing, conditional, looping, and procedures, but no way for a programmer to define new structures. One useful control structure that many languages omit is the simple *case* statement (given *N* alternative things to do, numbered from 1 to *N*, and a variable *K*, do the *K*th thing). If the language doesn't provide a case statement, you can always simulate it with a long string of conditionals, but it makes your program harder to read. Other useful control structures are much more difficult to simulate if the language fails to provide them.

The Smalltalk-80 language and system (which will be called simply "Smalltalk") is one of the few languages in which a programmer can invent and implement, with relative ease, new control structures that aren't provided by the system implementors. The rest of the article illustrates this point with examples that have actually been run on a Smalltalk-80 implementation.

What's Built In

Smalltalk provides very few built-in control structures. There is the conditional structure, implemented as follows:

```
someCondition ifTrue: [somethingToDo]
someCondition ifFalse: [somethingToDo]
someCondition
   ifTrue: [somethingToDo]
   ifFalse: [somethingElseToDo]
```

and the simple loop:

```
[someCondition] whileTrue: [somethingToDo]
[someCondition] whileFalse: [somethingToDo]
```

The most powerful tool for building new structures is the *block*. Two examples are:

```
[somethingToDoLater]
```

and:

```
[:anArgumentName| somethingToDoLater]
```

The block allows a caller to pass to the implementor of a control structure a piece of code to be executed (possibly with arguments, as in the second example) at an appropriate time.

Case Statement

Our first example is the case statement described before. We would like a construct that includes an indexed collection of blocks for the expected cases and another block for the situation where the index is out of range. Without any particular trouble we can have a construct like this:

```
someExpression
   case: (Array with: [case1] with: [case2] with:
      [case3])
   otherwise: [somethingElse]
```

where [somethingElse] gets evaluated if someExpression isn't 1, 2, or 3. Then the definition is simple. We add a message to the existing class Number. In order to distinguish adding methods to existing classes from creating new classes, we will label templates "existing" if they are to be seen as partial templates adding new methods to existing classes.

Table 1 shows the code necessary to add the case method to the class Number. As far as the control struc-

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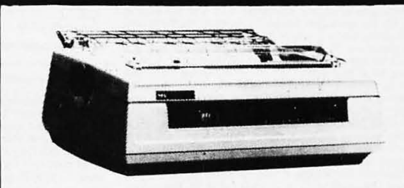
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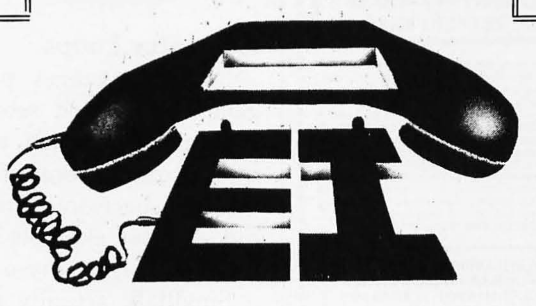
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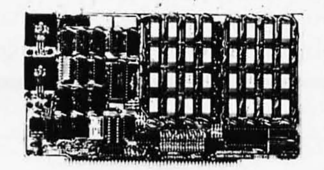
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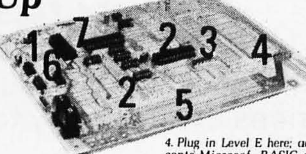
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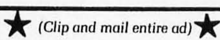
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ture goes, this is all there is to it: alternativeBlocks is an array of blocks, and the method in Number simply picks the appropriate one to evaluate. However, the syntax looks clumsy. We might like to have something that looks more like the following:

```
someExpression
    case: [case1], [case2], [case3]
    otherwise: [somethingElse]
```

One way to do this is to arrange for appropriate interpretation of the message , (comma) by BlockContext (table 2a) and to invent a new subclass of IndexedCollection (table 2b) that will also interpret , appropriately. We also have to add some protocol to BlockContext to handle the situation of a single block. Note that double quote marks delineate comments in Smalltalk.

As a matter of style, we generally discourage syntactic embellishments of this kind: their implementation tends to be obscure and they don't add that much to the ease of writing programs.

Generator Loops

Many languages provide a kind of loop called a *generator*, which sets a variable to successive values generated by some algorithm each time through the interior of the loop. The familiar kind of loop that runs through successive integers from 1 to *N* is one such example. Another example is looking at successive elements of a linked list, or any ordered collection.

Smalltalk actually provides simple generators of the form:

```
someCollection do:
    [:anElement| doSomethingWithTheElement]
```

but it is instructive to see how we could have constructed them ourselves. This could be accomplished by having each kind of collection object implement the message do:

class name (existing)	Number
superclass	"none added here"
instance variable names	"none added here"
class messages and methods	

"none added here"

instance messages and methods

```
control
case: alternativeBlocks otherwise: aBlock | |
    (self >= 1 and: [self <= alternativeBlocks size])
        ifTrue: [↑(alternativeBlocks at: self) value]
        ifFalse: [↑aBlock value]
```

Table 1: *Template showing additions to existing class* Number.

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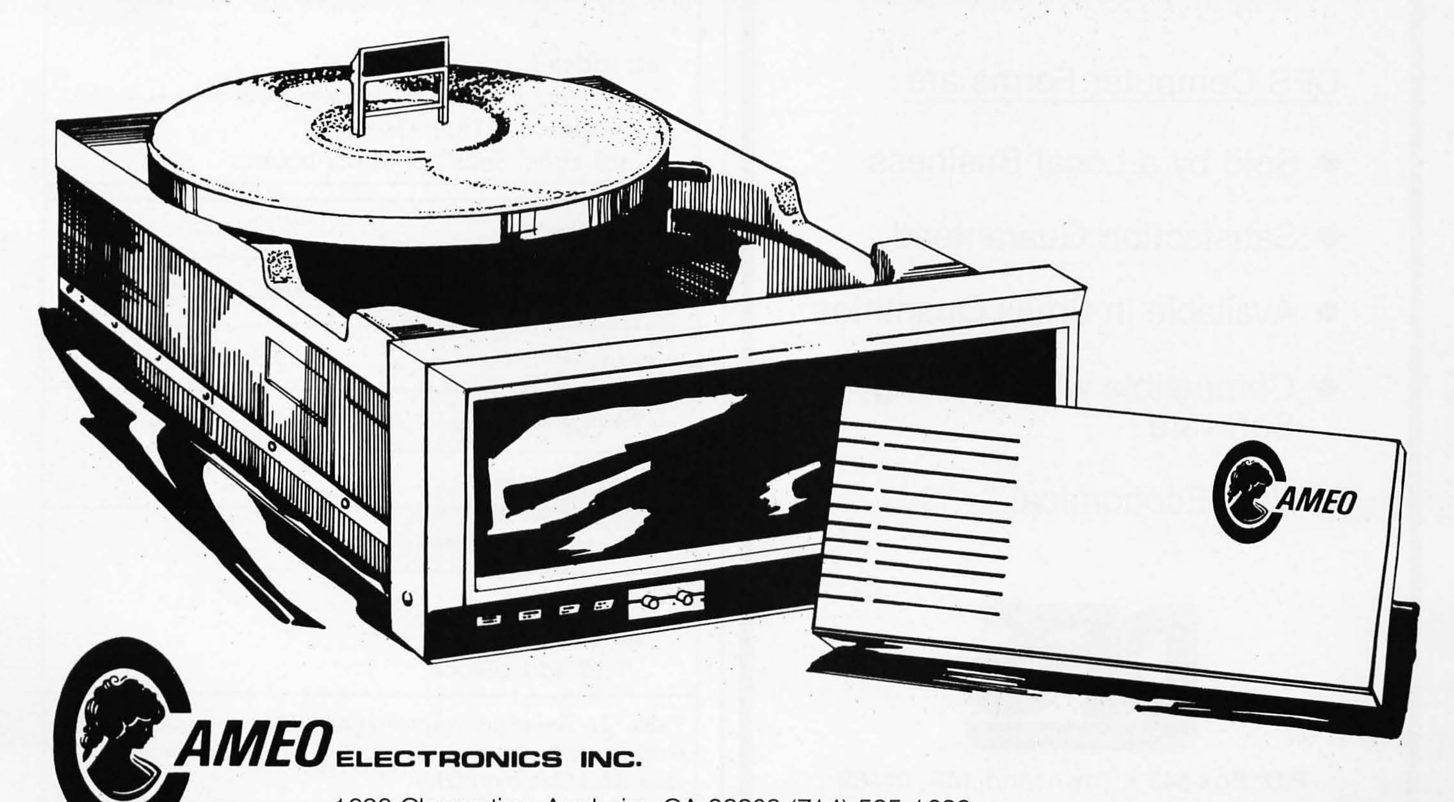
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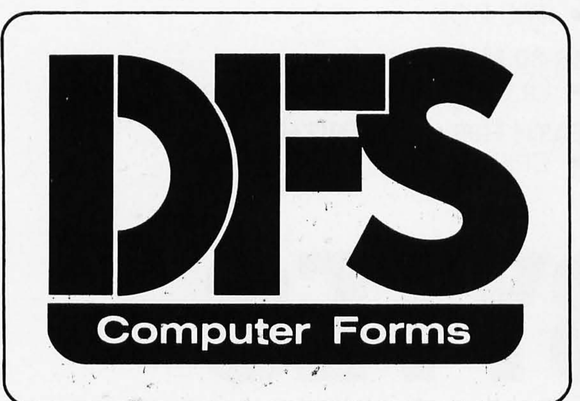


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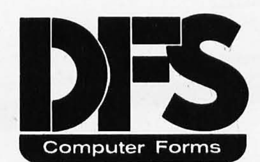
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directly; we would get simple arithmetic loops by using do: with an Interval, a kind of collection that represents a bounded arithmetic progression. Using do: is convenient when we know that we want to look at all the elements of the collection, and do the same thing to each one. For example IndexedCollection might implement do: as shown in table 3.

However, if we want to retain more flexibility in controlling the generation process, there is a better way. We define the notion of a *supplier*, which will deliver the elements of a collection one at a time in response to messages. The protocol (set of messages and their intended meanings) for suppliers consists of the messages:

s atEnd

class name (existing)	BlockContext
superclass	"none added here"
instance variable names	"none added here"
class messages and methods	

"none added here"

instance messages and methods	

```
constructing
, aBlock | |
    ↑BlockCollection with: self with: aBlock
accessing
size | |
    "Behave like a BlockCollection with self as the only element"
    ↑1
at: index | |
    "Behave like a BlockCollection with self as the only element"
    index = 1 ifTrue: [↑self].
    self error: 'Subscript out of bounds'
```

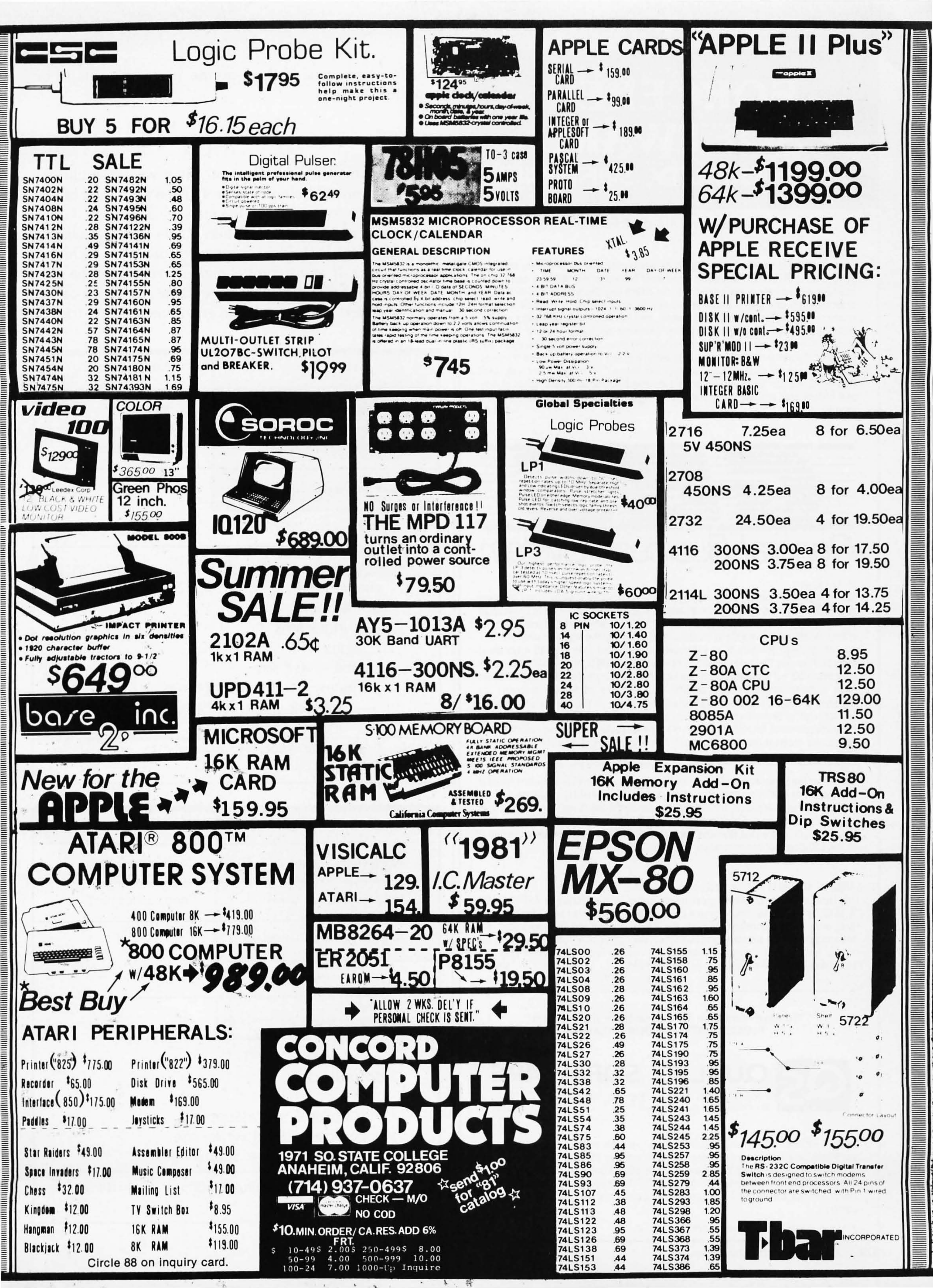
class name (existing)	BlockCollection
superclass	IndexedCollection
instance variable names	"none defined here"
class messages and methods	

"none defined here"

instance messages and methods	

```
constructing
, aBlock | |
    ↑self add: aBlock
```

Table 2: *Templates showing additions to existing class* BlockContext *(2a) and the creation of a class template for class* BlockCollection *(2b).*



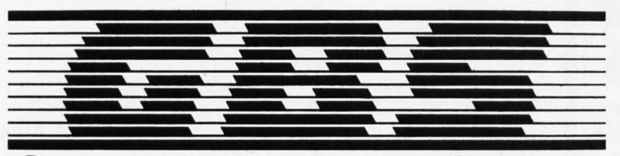
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which returns true if there are no more elements to be supplied, and:

```
s next
```

which returns the next element. Now we can build our do: operation as shown in table 4. Then each kind of collection needs to implement the message asSupplier, which returns an appropriate supplier. Table 5 shows what a supplier might look like for IndexedCollection (including its creation). If an attempt is made to read past the end, position will be incremented beyond the size of the collection, and next will provoke an error when the at: tries to

class name (existing)	IndexedCollection
superclass	Collection
instance variable names	"none added here"
class messages and methods	
"none added here"	
instance messages and methods	

```
enumeration
do: aBlock
    | index limit |
    index ← 1.
    limit ← self size.
    [index < = limit] whileTrue:
        [aBlock value: (self at: index).
        index ← index + 1]
```

Table 3: *Template showing additions to existing class* IndexedCollection.

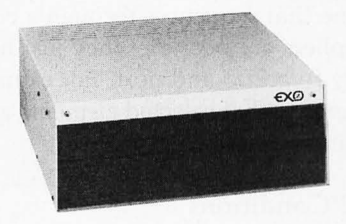
class name (existing)	Collection
superclass	"none added here"
instance variable names	"none added here"
class messages and methods	
"none added here"	
instance messages and methods	

```
enumeration
do: aBlock
    | supplier |
    supplier ← self asSupplier.
    [supplier atEnd] whileFalse:
        [aBlock value: supplier next]
```

Table 4: *Template showing additions to existing class* Collection.

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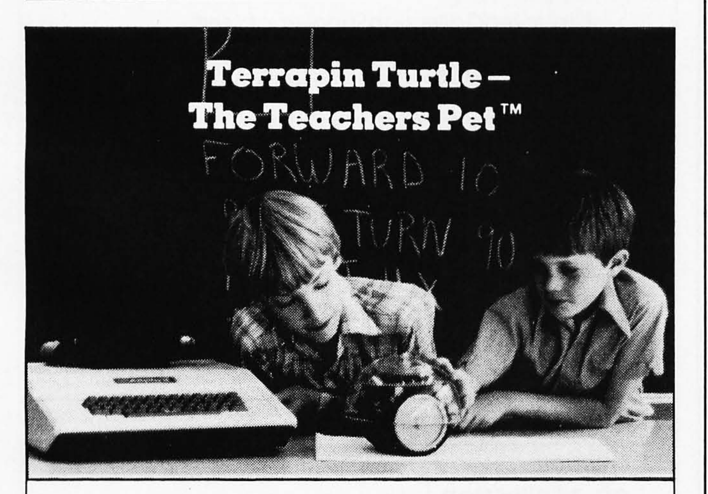
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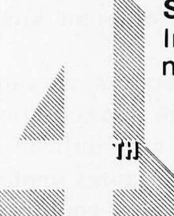
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access an element beyond the size. An alternative approach, which gives a more useful error message at the expense of duplicating a check that at: must perform anyway, is to define next as follows:

```
next | |
   position > = collection size
      ifTrue:
         [self error: 'Attempt to read beyond last
            element'].
   position ← position + 1.
   ↑ collection at: position
```

Similar supplier classes would be needed to provide generation capability for all of the different kinds of Collections.

With the supplier approach to generators, we can easily build a loop that sequences through two collections in parallel (see table 6). This would be very difficult if we did not have suppliers, but made collections implement do: directly. The problem is that while we could use do: to get one of the two collections to deliver its elements to a block of our choosing, there would be no way to get the other collection to deliver exactly one element each time the block is invoked.

Suppliers are so useful as a concept and as a protocol that Smalltalk actually includes them, under the name of ReadStream. The important point is that we could have built them ourselves if the system implementors hadn't gotten there first.

Although the only kind of supplier we have constructed is one that sequences through a collection, other kinds of suppliers are possible: they just have to respond appropriately to atEnd and next. For example, one could imagine a supplier that selected elements at random from a collection in response to next.

Exceptional Conditions

One of the difficulties in designing programs that (at least appear to) work reliably is designing the control structures for handling "infrequent" events. An infre-

class name (existing)	IndexedCollection
superclass	"none added here"
instance variable names	"none added here"
class messages and methods	

"none added here"

instance messages and methods	

enumeration
asSupplier | |
   ↑ IndexedCollectionSupplier of: self

class name	IndexedCollectionSupplier
superclass	Object
instance variable names	collection position
class messages and methods	

creation
of: aCollection | |
   ↑self new of: aCollection

instance messages and methods	

creation
of: aCollection | |
   collection ← aCollection.
   position ← 0

accessing
atEnd | |
   ↑position > = collection size
next | |
   position ← position + 1.
   ↑collection at: position

Table 5: *Templates showing additions to existing class* IndexedCollection *(5a) and the creation of a class template for class* IndexedCollectionSupplier *(5b).*

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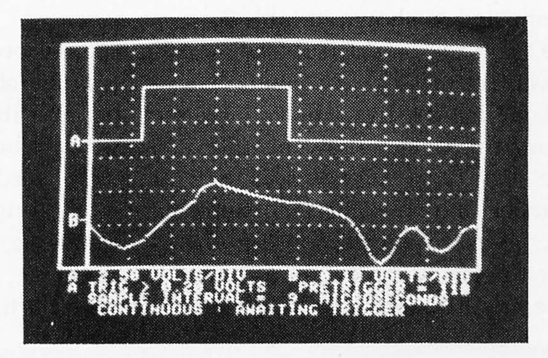
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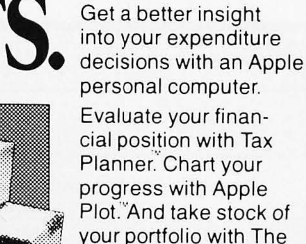
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quent event is any event which is (a) qualitatively different from what happens most of the time and (b) not so common that one wants to test for it in the normal flow of control. One example of an infrequent event is an additional exit from a loop. Suppose we would like to write a searching loop that finds the maximum element of a collection of non-negative numbers but stops searching if it finds an element greater than 1000. Such a loop might be implemented as shown in table 7.

We want the block [[supplier atEnd] ...] to respond to the withExit message by giving back a blocklike object which we can assign to the variable theLoop. The ability to name this object allows us to exit from it midcourse. These BlockWithExit objects (see table 8) need to remember only two pieces of information: the original block, to execute in response to the value message, and where to send control if an exit message is sent.

The original statement theLoop ← ... doesn't actually

class name (existing)	Collection
superclass	"none added here"
instance variable names	"none added here"
class messages and methods	

"none added here"

instance messages and methods

```
enumerating
with: anotherCollection do: aBlock
    | mySupplier itsSupplier |
    mySupplier ← self asSupplier.
    itsSupplier ← anotherCollection asSupplier.
    [mySupplier atEnd or: [itsSupplier atEnd]]
        whileFalse:
            [aBlock
                value: mySupplier next
                value: itsSupplier next]
```

Table 6: *Template showing additions to existing class* Collection.

class name (existing)	OrderedCollection
superclass	"none added here"
instance variable names	"none added here"
class messages and methods	

"none added here"

instance messages and methods

```
searching
maxBefore1000
    | supplier max value theLoop |
    max ← 0.
    supplier ← self asSupplier.
    theLoop ←
        [[supplier atEnd]
            whileFalse:
                [value ← supplier next.
                value > 1000 ifTrue: [theLoop exit].
                max ← max max: value]] withExit.
    theLoop value. "Actually do the loop block"
    ↑max
```

Table 7: *Template showing additions to existing class* OrderedCollection.

class name	BlockWithExit
superclass	Object
instance variable names	block exitBlock
class messages and methods	

```
creation
with: aBlock | |
    ↑ self new with: aBlock
```

instance messages and methods

```
creation
with: aBlock | |
    block ← aBlock

control
value | |
    exitBlock ← [↑ nil]. "Exit to my caller if the block ever
    sends me the exit message"
    ↑ block value "Actually do the computation"
exit | |
    exitBlock value "Exit from the computation to the caller
    who sent the value message to me in the method just above"
```

class name (existing)	BlockContext
superclass	"none added here"
instance variable names	"none added here"
class messages and methods	

"none added here"

instance messages and methods

```
control
withExit | |
    ↑ BlockWithExit with: self
```

Table 8: *Templates showing the creation of a class template for class* BlockWithExit *(8a) and additions to existing class* BlockContext *(8b).*

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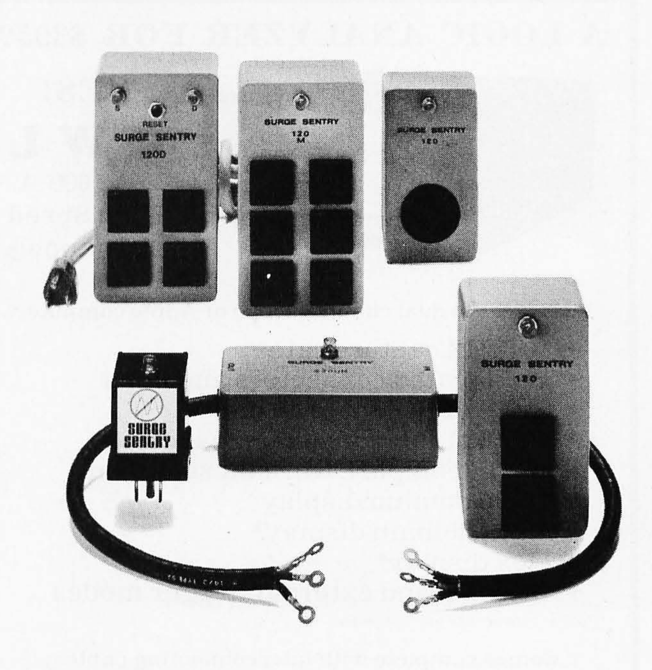
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execute the loop: it creates a block whose code is [supplier atEnd] ... . This block becomes the block variable of a new BlockWithExit as a result of the withExit message being sent. theLoop is set to the BlockWithExit just created. When theLoop is sent the message value, the value method in BlockWithExit first creates another block, the exitBlock, which, if evaluated, will return to the sender of value *regardless of how many other activations have intervened*. The value method in BlockWithExit then sends value to the original block, causing it to execute. If no exit is sent, the loop completes normally. If an exit is sent, the exitBlock is evaluated and control returns to the last statement of maxBefore1000, just as if the loop had completed.

Dynamic Binding

Another common kind of infrequent event is a request for information. For example, suppose we want to specify a default directory for disk files throughout some part of a program. We could pass this information as an argument through all intervening calls, but this would place an added burden (in time, space, and complexity) on many parts of the program that have no interest in this information. An alternative would be to set a global variable before starting the computation, and reset it afterwards; unfortunately, if the computation is interrupted (say by something like the loop exit construct we described earlier), this leaves the variable with the wrong value. Ideally, we would like to set up a structure that will get control if the default information is ever needed, without getting in the way of the rest of the program. Such an arrangement is called *dynamic binding*. We will illustrate how it can be used both for data and control.

Suppose we want to write something such as the following:

```
#defaultDirectory bindTo: 'Smith' in:
   [someComputation]
```

and then have the file system be able to ask for the current default directory by:

```
#defaultDirectory binding
```

Since we want the binding of defaultDirectory to 'Smith' to last only for the duration of someComputation, it follows that in order to find the binding of a dynamic variable, we must examine the data structures that Smalltalk uses to represent the state of a computation. In

class name	Binding
superclass	Association "Provides key and value variables, and messages for accessing them"
instance variable names	"none defined here"
class messages and methods	

creation
of: aSymbol to: aValue in: aBlock | |
  ↑ self new of: aSymbol to: aValue in: aBlock

instance messages and methods	

initialization
of: aSymbol to: aValue in: aBlock | |
  key ← aSymbol.
  value ← aValue.
  ↑ aBlock value "Actually does the computation"

class name (existing)	Symbol
superclass	"none added here"
instance variable names	"none added here"
class messages and methods	

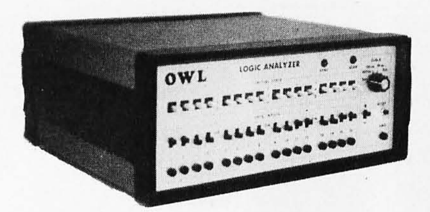
"none added here"

instance messages and methods	

binding
bindTo: value in: aBlock | |
  ↑ Binding of: self to: value in: aBlock

Table 9: *Templates showing creation of a class template for class* Binding *(9a) and additions to existing class* Symbol *(9b).*

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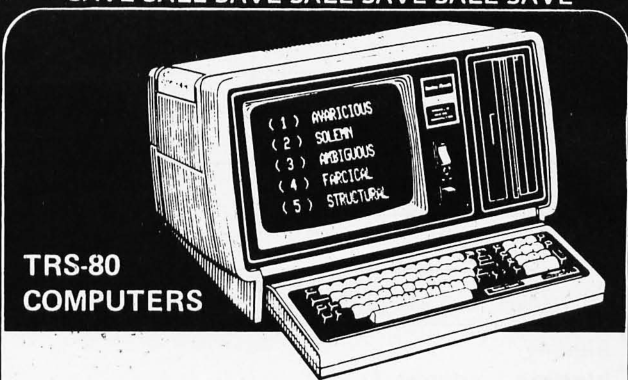
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class name (existing)	Symbol
superclass	"none added here"
instance variable names	"none added here"
class messages and methods	
"none added here"	
instance messages and methods	

```
binding
binding | context |
   context ← thisContext. "Start here. thisContext is a
   machine register"
   [context = nil] whileFalse:
      [((context receiver isMemberOf: Binding)
         and: [context selector = #of:to:in: "Is it a
         binding..."
         and: [context receiver key = self]])   "...of this
         variable?"
            ifTrue: "Yes, return its value"
               [↑ context receiver value]
            ifFalse: "No, go on to the next context in the
            chain"
               [context ← context sender]].
   self error: ('No binding for' concatenate: self )
```

Table 10: *Template showing additions to existing class* Symbol.

particular, even though many messages may be sent in someComputation before the file system needs to find the binding of defaultDirectory, there must be some way to search the stack of methods that have been started but not completed, looking for whatever represents the binding of defaultDirectory. In Smalltalk, each element of this stack is a MethodContext object, and the variable in a MethodContext that refers to its caller is called its *sender*. So searching this stack just means checking the current context's sender, its sender, and so on, until we find a binding of the variable. We know we have found a binding when we recognize a MethodContext in which the receiver of the message is a Binding (see tables 9a and 9b), and which was created in response to a particular message. During this computation (↑ aBlock value in table 9a), a MethodContext will exist in which the receiver is the Binding and the message is of:to:in:. This is how we recognize a binding in the stack of MethodContexts. The searching process is shown in table 10.

Note that by combining dynamic binding with the ability to name exit points (eg: by doing #theExit bindTo: to create a BlockWithExit), we can arrange for dynamically bound exceptional events to stop a computation in midstream. More complicated arrangements that allow the parts of the computation being stopped to clean up after themselves are also easy to construct.

Coroutines

Generator loops are an example of *producer/consumer*

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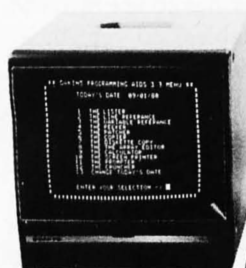


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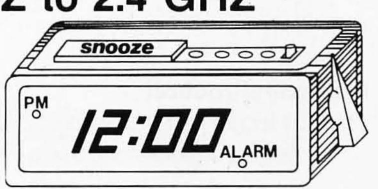
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structures: the supplier produces elements, and the program that invoked the loop construct consumes them. As we saw earlier, one way to do this is to assign responsibility as follows:

Producer

implements: do: aBlock
delivers values by: aBlock value: theNextElement

Consumer

receives values using: [:elementName| dosomethingToTheElement]

Under this arrangement, the producer can use any desired control structure internally, just by sending the message:

```
aBlock value: theNextElement
```

to the block whenever a new element has been generated; the consumer, however, is confined to executing the same block for each element. The other arrangement reverses the situation:

Producer

implements: atEnd, next
delivers values by: returning a value from next

Consumer

receives values using: producer next



Under this arrangement, the producer has to use *instance variables*, rather than control variables, to remember what state it is in, but the consumer can call for new elements using any control pattern it wants.

The control structure *coroutines* allows *both* the producer and consumer to use any control pattern. Notice that in the first arrangement, the producer has to retain its argument aBlock to be able to send it value: for each element; in the second arrangement, the consumer has to retain the producer to be able to send it next for each element. In the coroutine arrangement, both sides retain a common object called a *port*. The purpose of the port is to remember the control state of one partner while the other partner is running. Let us now build a port in which the consumer invokes the producer with the messages next and atEnd, and the producer invokes the consumer with the messages nextPut: anElement and markEnd. A loop in this implementation might look similar to the following:

Consumer

```
| first second |
portForProducer ← someCollection asProducer.
"Here is a sample loop that takes elements two at a time"
[portForProducer atEnd]
   whileFalse:
      [first ← portForProducer next.
      second ← portForProducer next.
      "Do something with first and second"]
```

Producer Collection

```
asProducer | port |
   port ← Port new.
   port producer: [CollectionProducer of:
     self with: port].
   "Create a new process for the producer"
   ↑ port
```

CollectionProducer

```
of: aCollection with: portForConsumer | |
      "Here is a sample loop that generates elements three at a
      time"
      [someCondition]
         whileTrue:
            [portForConsumer nextPut:
               someComputation1.
            portForConsumer nextPut:
               someComputation2.
            portForConsumer nextPut:
               someComputation3].
      portForConsumer markEnd
```

The code in both consumer and producer can involve any combination of loops, messages, or other control structures: the consumer can request a new element at any time with portForProducer next, and the producer can deliver an element any time it has control with port-

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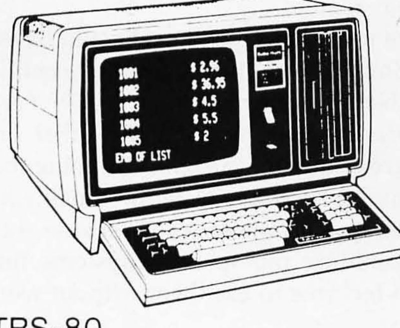
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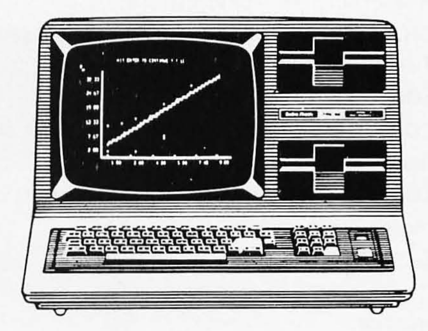


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ForConsumer nextPut: anElement. Interleaving a consumer that wants pairs of elements with a producer that generates triplets is a very simple example of the freedom that both partners enjoy in this arrangement.

To implement Port we need to consider how Smalltalk allows us to get hold of our current control state, since whenever control goes from consumer to producer or vice versa, we have to save the state of the partner that is giving up control. For just such purposes, Smalltalk provides a primitive notion of a *process*, an entity which has its own control state and can be suspended and resumed. The usual way to create a new process is with:

```
aProcess ← [someComputation] newProcess.
```

The process can then be started up by:

```
aProcess resume
```

and it will compute "in parallel" with the current computation until it finishes someComputation or it (or some other process) executes:

```
aProcess terminate
```

which stops it midflight. Alternatively:

```
[someComputation] fork
```

creates and starts an unnamed process that will proceed until the computation finishes.

To allow processes to synchronize their control or their use of data in an orderly way, Smalltalk provides *semaphores*. A semaphore logically represents the current availability of a finite resource: aSemaphore signal indicates that one unit of the resource has just become available, and aSemaphore wait indicates that the currently running process needs to take one unit of the resource and must wait if none is available (presumably until some other process does aSemaphore signal). A useful special case of this is a semaphore that always holds either 1 (meaning a resource is available) or 0 (meaning it is unavailable).

As an aside, we note that semaphores could have been implemented in Smalltalk (ie: not as primitive entities) at a considerable cost in performance: we only need the ability to temporarily guarantee that no other process could run aside from the one currently running (on this processor in a multiprocessor system). Smalltalk provides semaphores at a primitive level because they are such a help in building multiprocess systems that we wanted people to feel free to use them without worrying about their cost.

Given processes and semaphores, we are ready to implement Port (see table 11). The producer and consumer will each run in a process of their own, and we will use semaphores to make sure only one of them is running at a time. (The reader can easily imagine and might enjoy thinking about a version of coroutines which allows the producer to "get ahead" of the consumer. This requires a queue between the two, like the SharedQueue we will develop later.) The "resource" controlled by the semaphores will be free access to the variables in the port, nextElement and endMark, under the following arrange-

class name	Port
superclass	"none added here"
instance variable names	consumerSemaphore producerSemaphore nextElement endMark
class messages and methods	

```
"none defined here"
```

instance messages and methods

```
initialize
producer: aBlock | |
    "Assume we are running in the consumer process, so create a
    new process for the producer."
    endMark ← false.
    consumerSemaphore ← Semaphore new.
    producerSemaphore ← Semaphore new.
    producerSemaphore signal. "So producer will proceed
    the first time"
    aBlock fork
consumer
next | anElement |
    consumerSemaphore wait. "Wait for producer to deliver
    an element"
    endMark ifTrue: "No more elements"
        [self error: 'Attempt to read past last element'].
    anElement ← nextElement.
    producerSemaphore signal. "Restart producer"
    ↑ anElement
atEnd | |
    consumerSemaphore wait. "Wait for an element or end
    mark"
    consumerSemaphore signal. "Doesn't consume the ele-
    ment"
    ↑ endMark

producer
nextPut: anElement | |
    producerSemaphore wait. "Wait for consumer to have
    taken last element"
    nextElement ← anElement.
    consumerSemaphore signal "Restart consumer"
markEnd | |
    producerSemaphore wait.
    endMark ← true.
    consumerSemaphore signal
```

Table 11: *Class template for class* Port.

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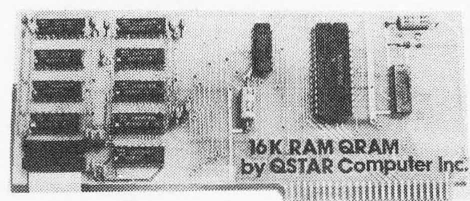
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Consumer	Producer
"In portForProducer next:" consumerSemaphore wait. "Semaphore started with 0, consumer waits."	
	"In port nextPut:" producerSemaphore wait. "Semaphore started with 1, now has 0" nextElement ← anElement. consumerSemaphore signal. "Semaphore started with 0, now has 1"
anElement ← nextElement. producerSemaphore signal. "Semaphore had 0, now has 1" ↑ anElement	
	"nextPut: returns, producer proceeds." "Later, producer does another port nextPut:" producerSemaphore wait. "Semaphore goes from 1 to 0 again"

Table 12: *Dialog between consumer and producer objects using the* Port *defined in table 11.*

ment: when consumerSemaphore has a 1, it means nextElement has something in it (or endMark has been set) and the consumer needs to run; when producerSemaphore has a 1, it means nextElement is vacant and the producer needs to run. Notice that the next and nextPut: methods are very similar.

A partial trace through an exchange of control would look like the dialog shown in table 12. Note that if the producer reached the second wait before the consumer took the first element, the producer would wait until the consumer did the producerSemaphore signal. A full discussion of how semaphores should be used to produce minimum waiting, minimum process switching, and correct synchronization is beyond the scope of this article; one important and useful special case will be presented in the following section.

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class name	Queue
superclass	Object
instance variable names	array writer reader
class messages and methods	

creation
new: size | |
↑ self allocate init: size

instance messages and methods

initialization
init: size | |
array ← Array new: size.
reader ← 0.
writer ← 0
access
removeFirst | |
reader ← reader + 1.
↑ array at: reader
addLast: anElement | |
writer ← writer + 1.
array at: writer put: anElement

Table 13: *Class template for an initial implementation of class* Queue.

Process A	Process B
reader ← reader + 1.	
	reader ← reader + 1.
↑ array at: reader	
	↑ array at: reader

Table 14: *Execution of the* removeFirst *method using the implementation of table 13.*

class name	SharedQueue
superclass	Object
instance variable names	array writer reader accessSemaphore
class messages and methods	

creation
new: size | |
↑ self allocate init: size

instance messages and methods

initialization
init: size | |
array ← Array new: size.
reader ← 0.
writer ← 0.
accessSemaphore ← Semaphore new.
accessSemaphore signal "Give it the baton"

Table 15: *Class template for class* SharedQueue.

semaphores for synchronizing their behavior.

From semaphores we can easily build a more useful construct, called a *monitor*. The purpose of a monitor is to allow several processes to communicate with a data structure without getting in each other's way; failing to provide for this is another common source of bugs—consider the simple-minded implementation of a queue given in table 13. (The reader should ignore the obvious bugs: there is no check for an empty queue or for exceeding the size of the array.)

Suppose two processes both try to remove an element at about the same time, and the removeFirst method gets executed as shown in table 14 (the flow of time is vertical down the page, interleaving the statements executed by process A in the left column and process B in the right). One element is skipped—and one is returned twice! The solution to this problem is to consider "permission to update the state of the queue" as a resource that only one process can hold at any given time, like the baton in a relay race. So we can construct a safe Queue by giving it a semaphore that starts out with one unit of the resource (see table 15).

A pattern we will encounter in the implementation of SharedQueue will be to reserve a resource during the execution of a piece of code:

```
someSemaphore wait.      "Acquire the resource"
someComputation.
someSemaphore signal.    "Release the resource"
```

The code someComputation is called a *critical section*. We would like to be able to write the previous code fragment as:

```
someSemaphore critical: [someComputation].
```

class name (existing)	Semaphore
superclass	"none added here"
instance variable names	"none added here"
class messages and methods	

"none added here"

instance messages and methods

critical sections
critical: aBlock | result |
self wait. "Acquire the resource"
result ← aBlock value. "Do the computation, save the result"
self signal. "Release the resource"
↑ result "Return the result of the computation"

Table 16: *Template showing additions to existing class* Semaphore.

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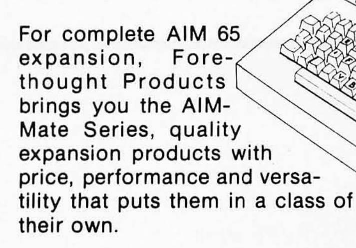
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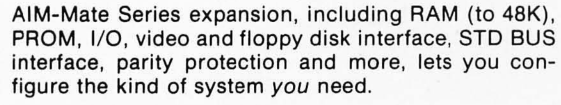
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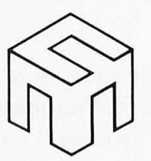
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The system actually provides this message to Semaphore, with a straightforward implementation which is shown in table 16. It is then easy to appropriately modify the two messages in SharedQueue (see table 17).

If two processes try to access the queue, the interchange shown in table 18 occurs (with a few steps left out). Note that the variable anElement is a local variable, and since the two processes have different contexts (despite the fact that they share the same instance of SharedQueue in this example), the variable anElement in Process A is different from anElement in Process B.

class name	SharedQueue
superclass	"none defined here"
instance variable names	"none defined here"
class messages and methods	
"none defined here"	
instance messages and methods	

```
access
removeFirst | anElement |
    ↑ accessSemaphore critical: "Reserve access for the duration of the block"
        [reader ← reader + 1.
        array at: reader]
addLast: anElement | |
    accessSemaphore critical: "Reserve access for the duration of the block"
        [writer ← writer + 1.
        array at: writer put: anElement]
```

Table 17: *Class template for class* SharedQueue.

Final Comments

Many languages don't have the flexibility we've just described; others, such as assembly language, have great flexibility at the expense of readability. What is it about the Smalltalk-80 language and system that makes all of the foregoing both possible and fairly readable? Three things come to mind:

- The existence of blocks, with and without arguments, and the simple square-bracket notation for writing them. This makes it possible to pass a piece of code to the implementor of a control structure, which can then execute the code whenever and however it is appropriate. ALGOL and LISP have constructs which capture some, but not all, of the power of blocks.
- The ability to manipulate the control state directly, as in the dynamic binding example. Of course disaster can result if you aren't careful, but a challenge like this is necessary to exploit the full power of your imagination. InterLISP (a widely used LISP dialect) has facilities which capture some of the power of Smalltalk in this area.
- The accessibility of the entire system to modification. Several of the examples we've described involve adding messages to fundamental classes like Object and BlockContext. Restraint is important here too. Several LISP systems derive tremendous power from this kind of openness.

Of course, we pay a price for all this flexibility and simplicity. A discussion of the time and space cost of blocks, visible control state, and a completely accessible system is beyond the scope of this article; we will just observe that the elementary instructions which implement control structures (branch, call, and return) take about the same proportion of the total execution time in a typical Smalltalk-80 implementation as they do in more conventional languages that don't use globally optimizing compilers. ■

Process A	Process B
accessSemaphore wait "Semaphore now has 0 units of resource" reader ← reader + 1.	
	accessSemaphore wait. "Waits here"
anElement ← array at: reader. accessSemaphore signal. "Process B can proceed now, but immediately reacquires the semaphore"	
	reader ← reader + 1. anElement ← array at: reader. accessSemaphore signal. ↑ anElement
↑ anElement	

Table 18: *Execution of the* removeFirst *method using the implementation of table 17.*

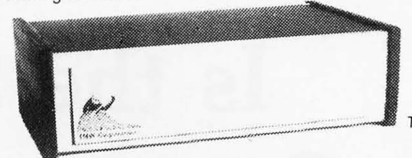
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Is the Smalltalk-80 System for Children?

Adele Goldberg and Joan Ross
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For many years our work on the Smalltalk project has carried with it the purpose of creating new technologies that can be used effectively for instruction, both to teach programming and to support the implementation of educational activities. While the Smalltalk-80 system is not specifically designed for school-age children, most of the applications that we developed as tests of the earlier Smalltalk systems were.

This article will present a brief history of the development of the Smalltalk-80 system that focuses on the instructional uses of its various predecessors. A significant part of this history is the redesign of the language syntax. Programming in Smalltalk involves creating a language for communicating among objects; this language is created within the syntactic restrictions of the Smalltalk-80 system. Often the programmer adds an additional level of syntax in which the language for communicating among objects is presented in terms of graphic images. An example of an instructional activity, the *Dance Kit*, illustrates the idea of such a language. Its design was motivated by the rich support for generalization and interactive graphics available in the Smalltalk-80 system.

Our original intention in writing this article was to *disabuse* readers of the idea that the Smalltalk-80 system, like LOGO, is a language for children. We concluded, however, that the other articles in this issue and the two books on the system (see references) will easily accomplish that task. It remains, then, for us to comment on the style of use of the system that our instructional work has taught us. Although there are a few places where knowledge of the Smalltalk-80 system is helpful, this article does not, in general, require such knowledge.

Learning to Program in Smalltalk

Initially when we ventured out into the schools to teach programming classes, we used a version of Smalltalk known as Smalltalk-72 (see reference 3). Our purpose in teaching these classes was threefold. First, we wanted to know if the language was teachable. In particular, we wanted to devise an appropriate pedagogical approach that could provide feedback on the design of the user interface as well as a basis for language redesign. And we wanted to begin to find out if software based on the concepts of objects and message-passing offered something special in the way of problem-solving tools for children and adults alike. The outcome of these investigations reinforced the value of the semantics of Smalltalk: that is, from the point of view of supporting computer-based problem solving, we found that the ability to organize information into objects that can be independently explored and linked together to create new kinds of behavior is a powerful computational tool.

Smalltalk-72 took the approach that the syntax was defined by the receiver of the message: the receiver read as much of the message as the receiver's method determined and then passed control to the next remaining token, which was seen as the receiver of the remainder of the message. This design came out of our assumption that the system user should have total flexibility in making the system be, or appear to be, *anything* that the user might choose. However, this meant that the only way that a reader could understand an expression was to execute the methods in his head. Furthermore, if a human could not parse an expression without executing the methods, the system itself would not be able to parse it. Thus Smalltalk-72 was a purely interpretive system, and its performance suffered accordingly.

The syntax design (or lack of it) was an example of taking the "flexibility" position to an extreme. Our experience in teaching Smalltalk-72 convinced us that overly flexible syntax was not only unnecessary, but a problem. In general, communication in classroom interaction breaks down when the students type expressions not easily readable by other students or teachers. By this we mean that if the participants in a classroom cannot read each other's code, then they cannot easily talk about it. Our intention was that the Smalltalk system serve as a communication mediator, but the lack of communication due to the runtime parsing of expressions was hindering this goal.

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syntax, making an incremental compiler a vital part of the system design. Expressions could be parsed by the human reader, although full understanding of the expressions required that the programmers choose identifiers and message names wisely. In this way, the programs could be read by other students or teachers. This approach to syntax remains in the Smalltalk-80 system.

In Smalltalk, languages are designed whenever the programmer specifies the message protocol of a class description. These are the languages with which objects in the system share information among themselves as well as with the human user. Users can profit enormously from defining their own language, learning about their native language in the process of constructing another. In addition, the concept of classes and instances provides a uniform way to organize information in Smalltalk. Communication and organization of information are fundamental aspects of problem-solving activities. In this regard, the needs of school children match those of system designers.

In order to teach Smalltalk programming, the pedagogical approach we developed is to present a fully implemented model of something that the student can use and then modify. The idea is to help early learners grow accustomed to computer interaction and to the notion of sending messages in order to invoke behavior from existing objects. The students can then create two or more instances of an existing class and, through experimentation with the messages to which the class of objects responds, discover the similarities and differences among the instances. In this way, the students apply observation and hypothesis-generating skills while enjoying a highly interactive, graphical discourse with the system. This latter characteristic depends, of course, on the user's ability to provide enticing visual displays of the instances.

We can use this pedagogical approach for learners with varying levels of skills by adjusting the complexity of the initial model. Instruction proceeds by having the students learn to "read" the description of the model (that is, the code). They then modify it so that each existing instance demonstrates a new, shared behavior (ie: the student adds a message/method to the class description). At this level, we are teaching students fairly standard programming skills that involve sequencing of messages to objects. The concept of naming variables was previously explored as part of the process of creating instances of classes. It is further explored in declaring and using temporary variables in support of a method. Self-reference in the form of messages to the object denoted by *self* comes naturally and is not dealt with as extraordinary. The curriculum framework we follow involves:

- use of an already existing model
- reproduction of the model with some addition
- substitution into the model to produce a new result
- introduction of the model into new contexts (ie: using it as a component of some other example)



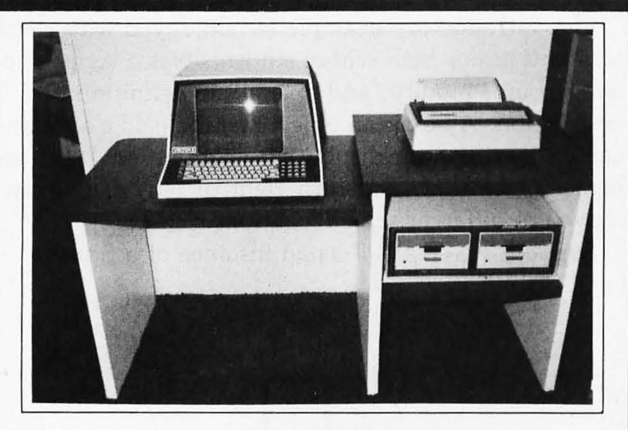


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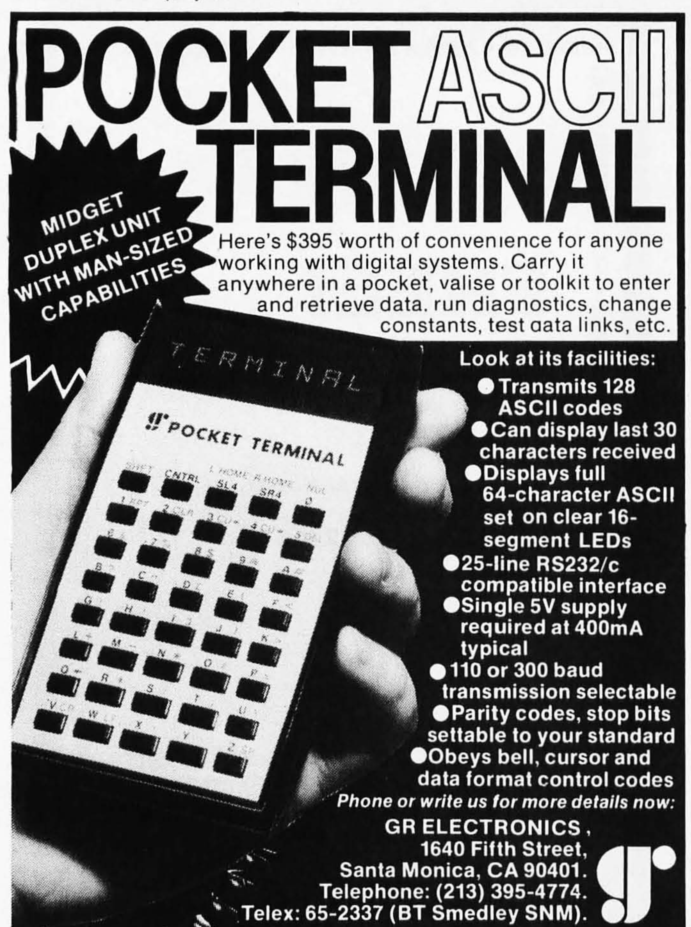
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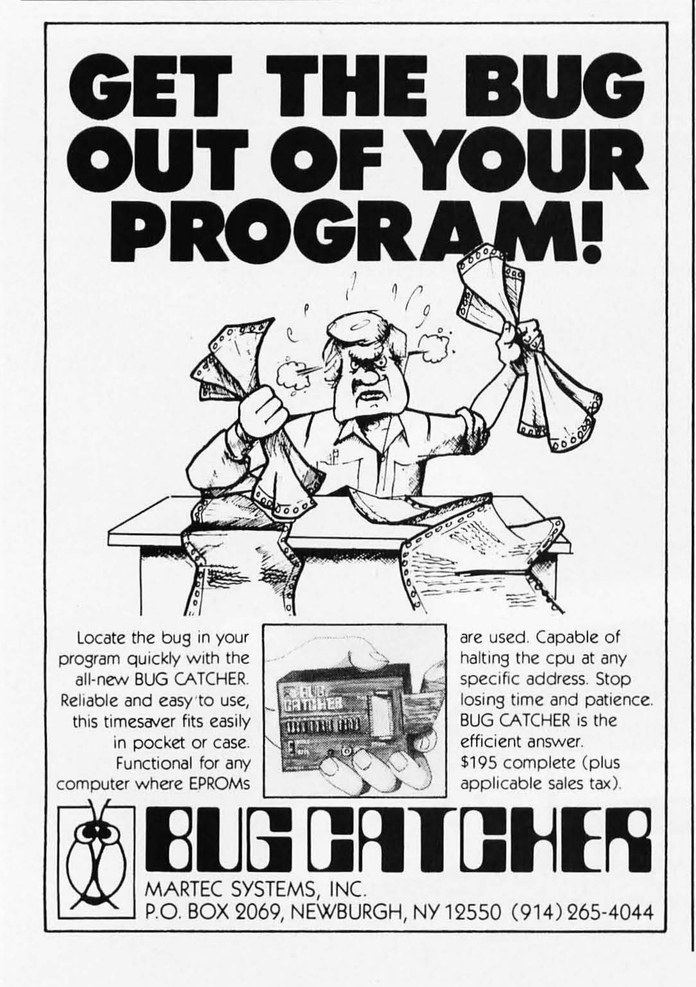


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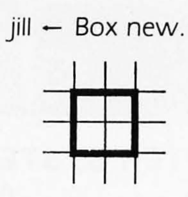




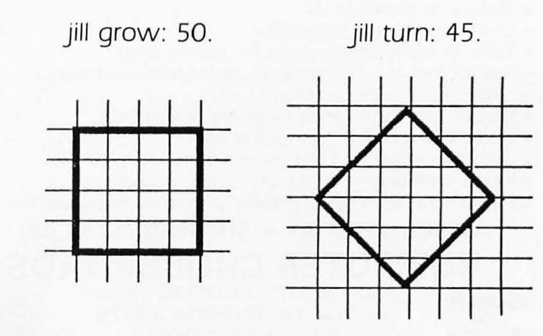
One introductory example we employed with elementary and junior high school students was a series of projects to use, modify, and extend the definition of a Box description. A box is an object that looks like a square: it can be drawn on the display screen or erased. It can grow bigger or smaller, and turn right or left, and it can be moved to different screen locations.

Suppose we create jill as an instance of a Box:

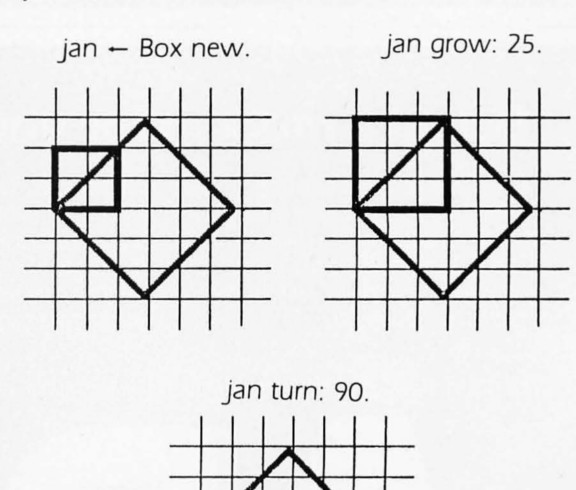
jill ← Box new.



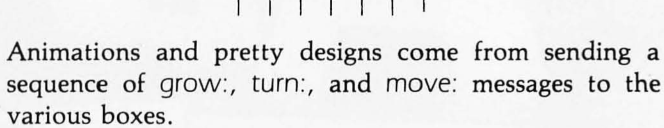
Then jill can grow and turn:



Many boxes can be created:



jan turn: 90.

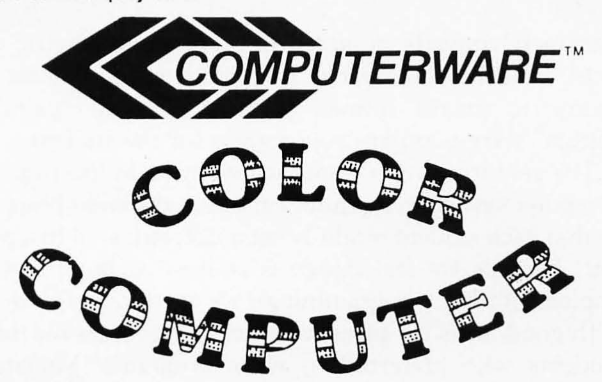


Animations and pretty designs come from sending a sequence of grow:, turn:, and move: messages to the various boxes.

Once the students used several instances of Box, they modified the definition of Box in order to have all its instances follow the display screen cursor as the cursor was moved about by a pointing device. Generalizations of Box led to descriptions of triangles, hexagons, and other polygons. Simple games of "leap frog" or space war

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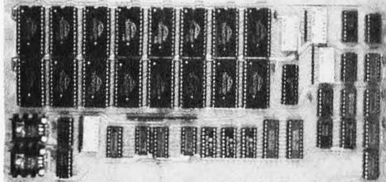
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were new contexts in which to place the geometric objects. Students discovered that judicious placement of geometric shapes formed pictures, and so "painting editors" were popular project areas for the students.

The resource-center approach we took in locating our computer system in a school emphasized shared projects, so that each student might bring a different skill to a project. Because we feel *design* is at least as important as implementation (programming), we encouraged students with good ideas for projects to act as resources for those students who preferred to write programs. Miniature research teams seemed to form in a natural way. The nonprogrammers on the team did their designs both visually (by sketching drawings of desired outcomes) and verbally. In the latter case, they designed by determining the needed objects and then specifying the language with which these objects would interact. The students benefited from the Smalltalk approach to description even before completing, or perhaps without completing, a running program.

After our experiences in the schools, we felt that further studies of graphical user interfaces were needed in order to improve the visual feedback Smalltalk provides as its programming interface. The Smalltalk-76 system was created primarily as a basis for implementing and studying various user-interface concepts. It gave the users, mostly adult researchers, further ability in refining existing classes through the use of subclassing. This meant that the programmer could now modify a running model without creating a change to already existing examples of that model. *Programming-by-refinement*, then, became a key idea in our ability to motivate our users.

Contrary to the idea that a computer is exciting because the programmer can create something from seemingly nothing, our users were shown that a computer is exciting because it can be a vast storehouse of already existing ideas (models) that can be retrieved and modified for the user's personal needs. Programming could be viewed and enjoyed as an evolutionary rather than a revolutionary act. The frustration of long hours of writing linear streams of code and then hoping to see some aspect of that code execute was replaced by incremental development. Emphasis was placed on learning how to make effective use of existing system components (objects in the Smalltalk sense). Much of the teaching we did was to show users how to search for and read the descriptions of the many useful components we and others (and even new users) continued to add to the system.

Fundamentally, the Smalltalk approach to software has exciting potential for educational use. But why only "potential"? As the system development work has proceeded from our initial work in the schools using Smalltalk-72, greater emphasis has been placed on providing a powerful system that is of interest to computer professionals as well as children. The Smalltalk-80 system, in its approach to providing a programming

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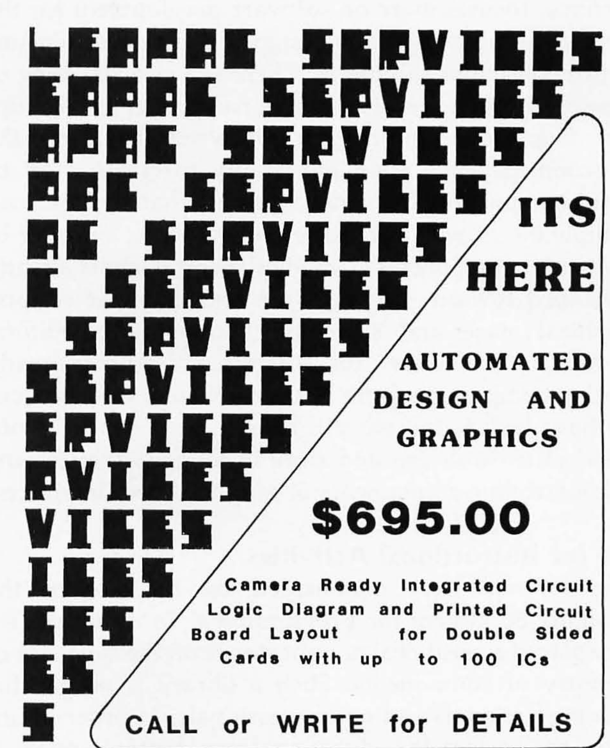
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interface, focuses more on software development for the *professional*. But the basic design of the system remains that of collections of objects. There is a clear layering of these objects in terms of system versus user-interface support. Our success in bringing this system back into the classroom depends upon our ability to create a set of useful components (class descriptions) that the user can manipulate, as well as modify and combine, in order to create new components. Among the components already developed toward this goal are text and text editors, graphical images and "sketching" and animation editors, as well as "browsers" for seeking out other, already existing components from libraries of such information. We have begun, but we still have a great deal of work ahead of us to design and store in libraries the viewing and controlling components of graphical user interfaces.

Kits for Instructional Activities

So far we have commented on the use of the Smalltalk-80 system for programming. In doing so, we have placed a great deal of importance on the existence of a library of components. Such a library is needed for both professionals and nonprofessionals. In order to improve the system for educational use, better support is needed to assist computer-based curriculum designers in developing flexible instructional activities (perhaps in the form of a special library). Several examples of instructional activities that have been implemented in Smalltalk-72 or Smalltalk-76 are described in Laura Gould and William Finzer's "A Study of TRIP: A Computer System for Animating Time-Rate-Distance Problems", (see reference 5) and Adele Goldberg's "Educational Uses of a Dynabook" (see reference 2).

More recently, we have been trying to work out the idea of a kit for constructing such activities. By a "kit" we mean a set of components and a set of tools (by means of which these components can be viewed and manipulated) that can be used to create many different but related things. Thus, the VisiCalc program (see reference 1) can be viewed as a kit for making business forms; any text editor is a kit for creating textual documents, and any "painting" system such as the Smalltalk ToolBox is a kit for making sketches (see "ToolBox: A Smalltalk Illustration System," by William Bowman and Bob Flegal, on page 369 of this issue).

For developing instructional activities, we believe that a kit can be used as an interface to hide the unnecessary details of the Smalltalk-80 system. A kit could provide a (possibly graphical) interface to the system for the user (student, teacher or curriculum developer) who prefers to focus attention on only one or two aspects of the system. In such a kit, we maintain the Smalltalk approach of selecting objects that respond by receiving a message. The experience gained using one level of the system can be applied to learning successively lower levels. Of utmost importance, the code that implements the kit should be accessible at the next level of interface so that the kit can act as a starting point for further refinement and instructional design.

For the most part, the kits we have designed create new programming interfaces. Most came about by looking at instructional activities from other systems and seeing which ones we liked. We then used the concepts of Smalltalk classes and instances in order to help us generalize the idea of the activity into kit form so that a teacher or student would be able to create personal variations of the activity. The remainder of this article presents an example of a kit that could be implemented in the Smalltalk-80 system.

Invitation to the Dance: Prelude

Imagine that you are a choreographer, able to direct the movements of a dancer on the stage. As the dancer follows your instructions and you see their effect, you may modify them, partly to more closely fulfill your initial images, and partly because observing the actual execution may give rise to new creative ideas.

Since you probably don't have access to a real stage and a real dancer, imagine that your computer's video screen is the stage on which you can direct the movement of a graphical dancer by means of a simple programming language. You can experiment with different sequences of instructions that direct your graphical dancer to replace parts of itself with other parts (thus raising and lowering its arms and legs) and to move in various directions across the screen. The system that allows you to create such dances is called the "Dance Kit."

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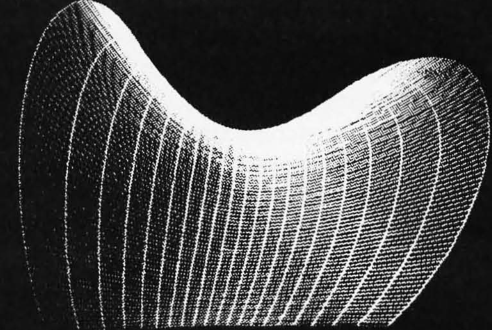
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Setting

The original idea for the Dance Kit came from Bill Finzer, a mathematics teacher at San Francisco State University. Bill was introducing a friend to a Commodore PET computer. Because both he and his friend are fans of an Indonesian dancer called Pak Jana, Bill conceived the idea of teaching his friend about programming in the context of choreography. He wrote a BASIC program called PAKJANA that allowed her to control the movements of a highly stylized dancer on the screen. (It has subsequently been used as a very successful introduction to programming for students in a course called "Computers without Fear.")

The PAKJANA figure is shown in figure 1. It is controlled by a sequence of commands, including a repetition construct. The commands either:

- replace a face, an arm, or a leg
- move the whole body up, down, to the right, or to the left
- create a pause (wait command)
- create a repetition of the commands

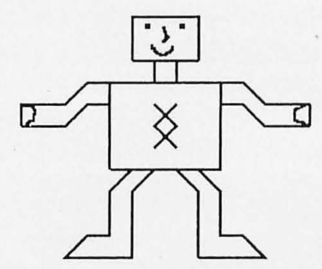


Figure 1: *The PAKJANA figure. Children were taught the basic ideas of programming by teaching this figure how to "dance."*

A large set of "replacement parts" is provided: there are nine different expressions and nine different positions in which any arm or leg may appear. The user specifies these replacement parts and the movements that the dancer can make by choosing from a list of commands in a very simple language. Thus, users can create programs that move the dancer in a predictable sequence of dance routines. (That users may initially find the effects of their programs not entirely predictable only adds to the fun.) The replacement parts for PAKJANA are shown in figure 2. (The program is available from Bill Finzer at the Center for Mathematical Literacy, Mathematics Department, San Francisco State University, 1600 Holloway, San Francisco CA 94132. The project was supported by an Academic Development Grant for the California State College System.)

Theme

Our Dance Kit evolved from Bill's BASIC program by considering possible extensions given the interactive graphics support of the Smalltalk-80 system. The goal of the Dance Kit is to provide a very flexible programming language by giving the user (the "programmer") the ability to draw the figure for which a dance can be choreographed. This figure not only moves about the screen, but also may change the position, size, shape, or color of its parts. One of the editing capabilities provided to the user of the kit is the ability to draw and subdivide the figure into parts. The user can then draw a set of images that replace each of the subdivisions. We call these replacement parts. They appear on the display screen as a part of the programming language the user can employ to create dance routines. An example figure is shown next to the label POSITIONS in figure 3. The user can view replacement parts of a particular subdivision by pointing on the screen to the part of the figure to be replaced. As an example, see the sequence of display screen views shown in figure 5 on pages 362 and 364.

The programming language also contains "steps" for placing the figure and "bridges" that allow repetition of some sequences of instructions. The steps, GO, TURN,

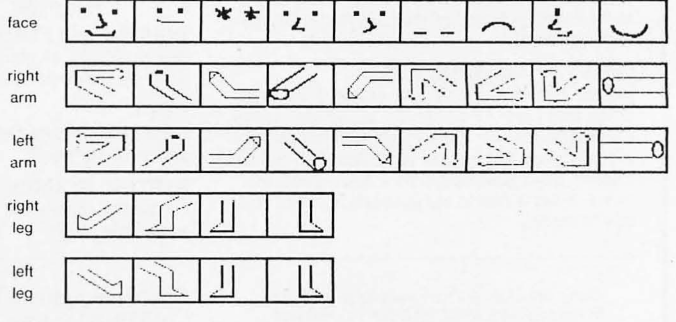


Figure 2: *Replacement parts for the PAKJANA figure. Combinations of these options allow the figure to be animated.*

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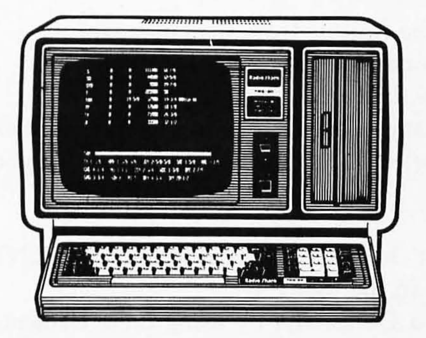
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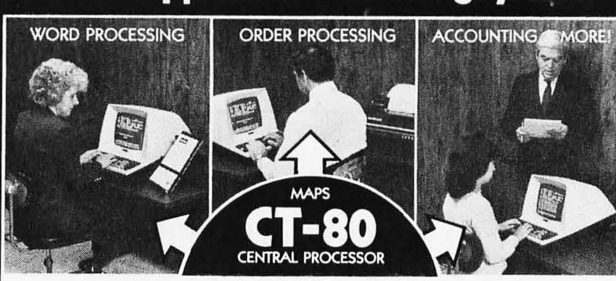
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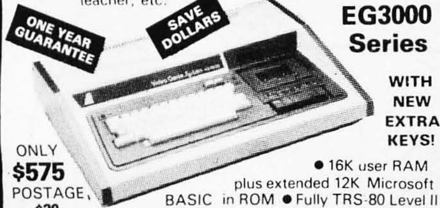
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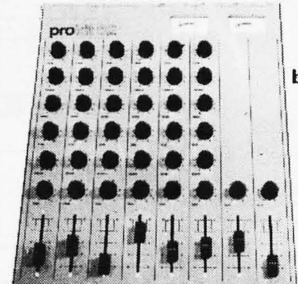
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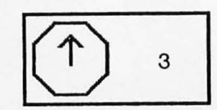
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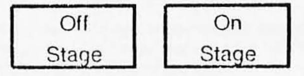
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and PAUSE, are given numerical parameters that indicate how large a step the figure should take. The user selects steps GO and TURN in cases where relative directional placement is desired. Alternatively, the user programs with a step that combines a direction and movement. For example, to take three steps in an upward (↑) direction, the step instruction is:



The user sets the arrow icon to specify the direction.

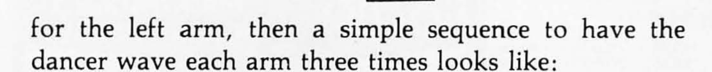
Bridge REPEAT is given a numerical parameter specifying the number of times a sequence of positions and steps should be repeated. Bridge REPEAT UNTIL is associated with a condition for terminating the repetition. We envision a fixed set of conditions such as:

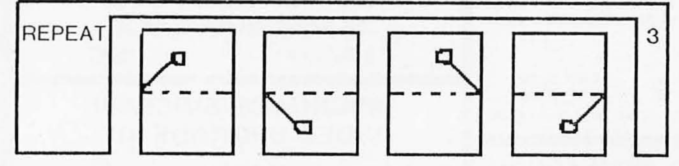


A GHOST bridge indicates that an image of the dancer should remain on the screen in the dancer's last position whenever the figure steps using the GO instruction. If replacement parts include:

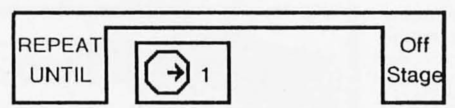
for the right arm, and:

for the left arm, then a simple sequence to have the dancer wave each arm three times looks like:

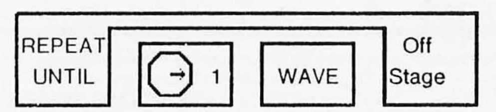




Notice that the replacement parts can overlap. For example, the arm parts are large and overlap the head part so that it is possible to lift the arms above the head. Similarly, the leg parts allow overlap with arm parts. The bridge "covers" the steps to be requested, with a condition specified at the right girder. The figure can slowly dance stage right using:



The user is also able to define "dance routines" that enable certain fixed sequences to be named, stored, retrieved for further editing, and used as a "sub-routine." Suppose the first sequence of commands is stored as the Dance Routine known as WAVE. We can then use this routine in another one to get:



On the screen, one routine (the one being edited by the user) is active at a time. Controls for managing routines are:

- DELETE (delete the routine from the language)
- STORE (store the current dance act as this routine)
- NEW (start a new dance act)
- COPY (make a dance act exactly like the current one)
- EDIT (make the selected routine be the current one you are editing)

A new dance act has the initial name CURRENT DANCE, as shown in the figure 4.

The user creates a Dance Act by using these elements (steps, bridges, and routines) of the programming language "DanceTalk" as shown in figure 4. This is done by simply pointing at the desired element and moving it

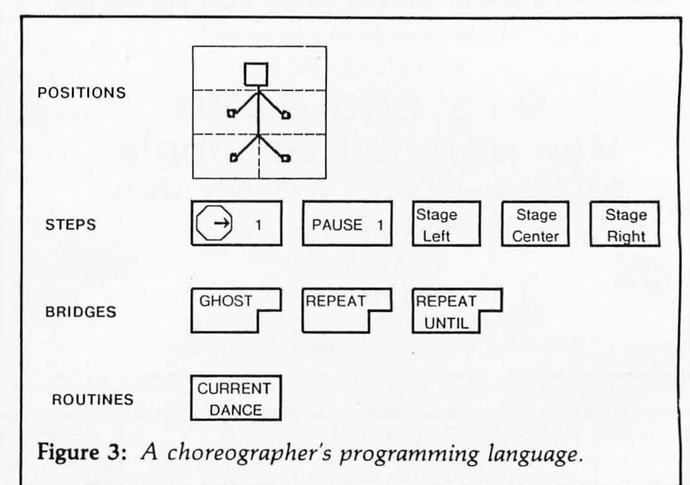


Figure 3: *A choreographer's programming language.*

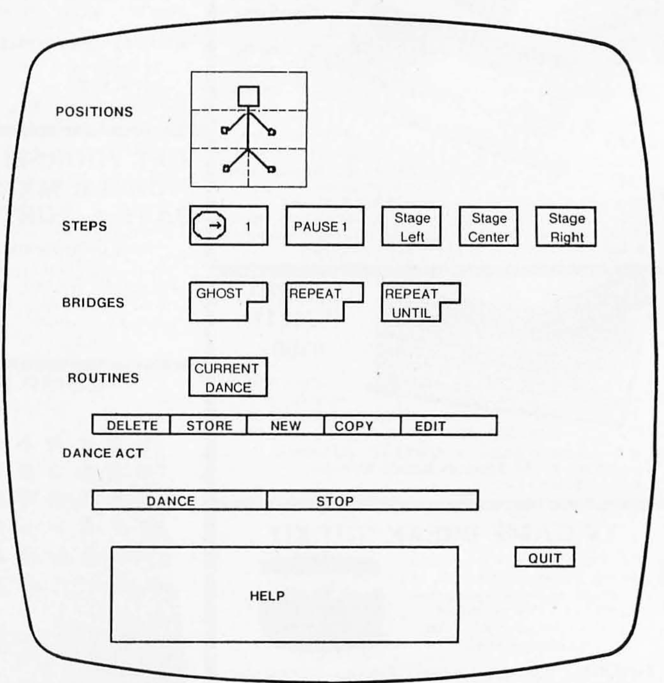


Figure 4: *A screen view of DanceTalk. This image, which appears on the video display of a Smalltalk system running the Dance Kit program, gives the user a menu of options with which to animate the "dancer."*

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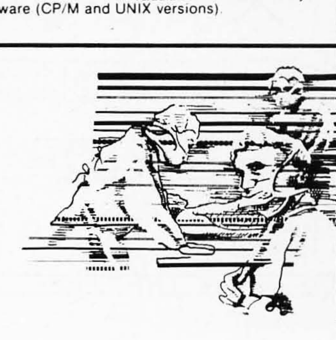
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into the initially empty area in the lower part of the screen. Selected elements are highlighted by complementing their screen area. Notice the rectangular area labeled HELP at the bottom of the screen. When the user points into this area, a description of what to do next is shown, or a comment about a selected element is given.

First Variation: The Stick Person

A user of our Dance Kit might see the sequence of screen views shown in figures 5a through 5f. After a user has completed a longer Dance Act with two choreographed (sub-)routines KICK and JUMP, the screen might look like figure 5f. Now when the user indicates DANCE in the bottom menu of commands, the top part of the screen clears as if a curtain were rising, and the user sees the given sequence of views—an animation (see figure 6).

Note that a grid with a scale underlies both the space and time dimensions. These could be specified and experimented with by the user.

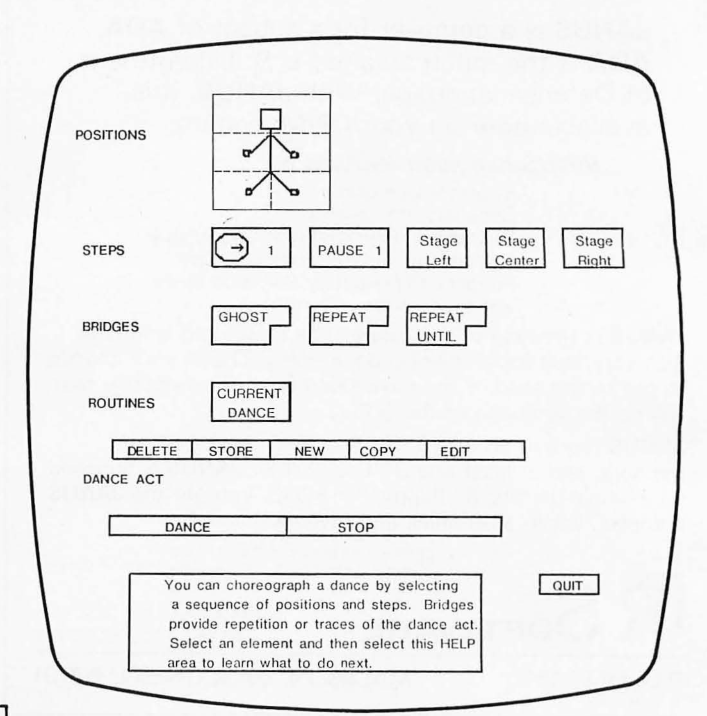
Second Variation: The Big Turtle

Our dancer may assume any size and shape we desire, and we can subdivide the dancer into any number of rectangular areas in order to create replaceable parts. The basic figure shown in figure 7 might be used. The dotted lines show the user's subdivision of the figure. Replacement parts for the section labeled D overlap section A, and might appear as shown in figure 8. Other replacement parts are left to the imagination of the reader.

Dance Acts can be shared by different figures, except that both replacement parts and routines will have to be

Text continued on page 365

(5a)



(5b)

POSITIONS
STEPS
1
PAUSE 1
Stage Left
Stage Center
Stage Right
BRIDGES
GHOST
REPEAT
REPEAT UNTIL
ROUTINES
CURRENT DANCE
DELETE
STORE
NEW
COPY
EDIT
DANCE ACT
DANCE
STOP
Notice that replacement parts for the selected area of the figure are now shown. You can select one and place it in the Dance Act.
QUIT

Figure 5: *Here and on page 364 are six views of the Dance Kit program during the creation of a dance. The "help" box, shown at the bottom of each figure, is always active. The shaded area indicates the item currently being worked on.*

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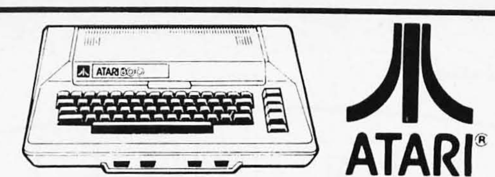
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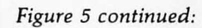
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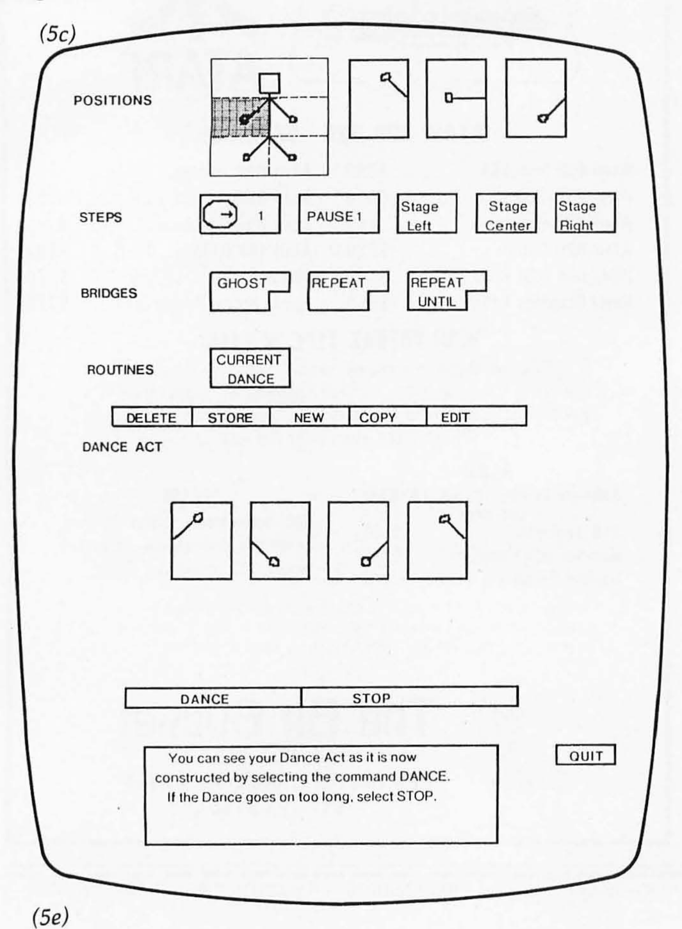
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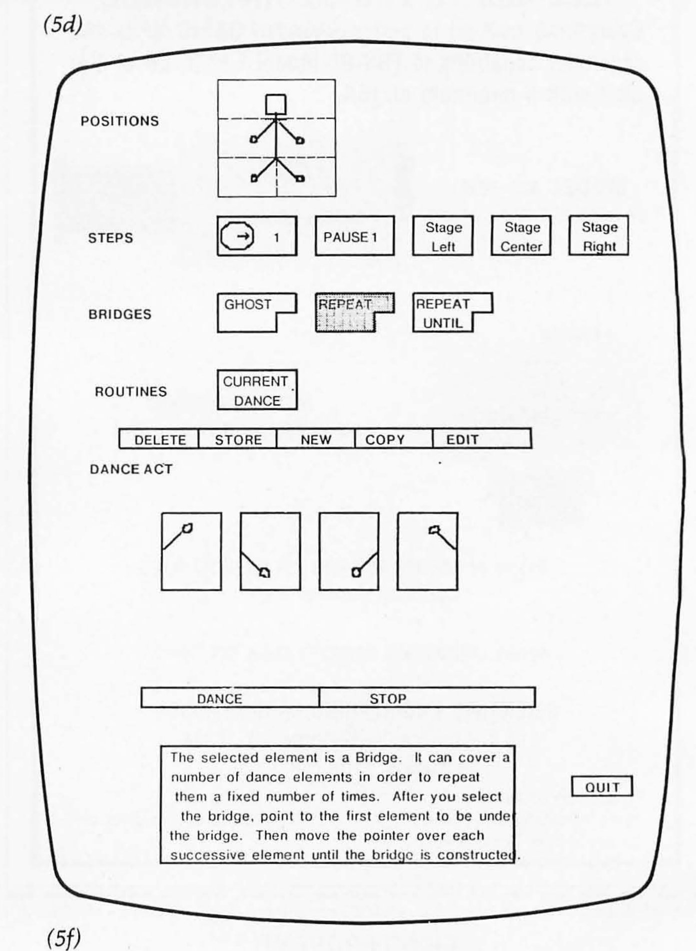
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Figure 5 continued:

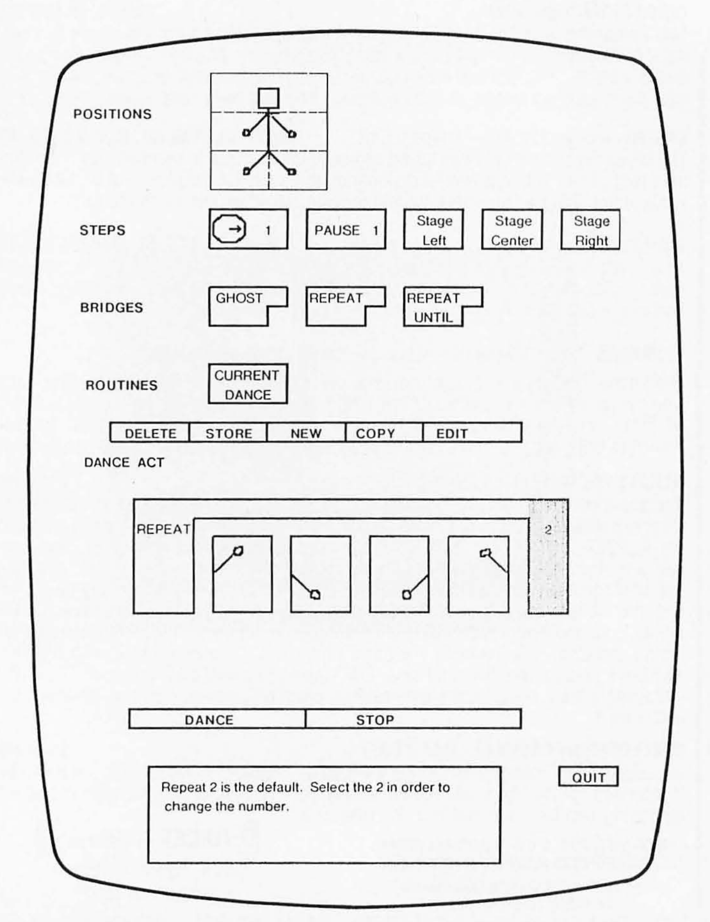
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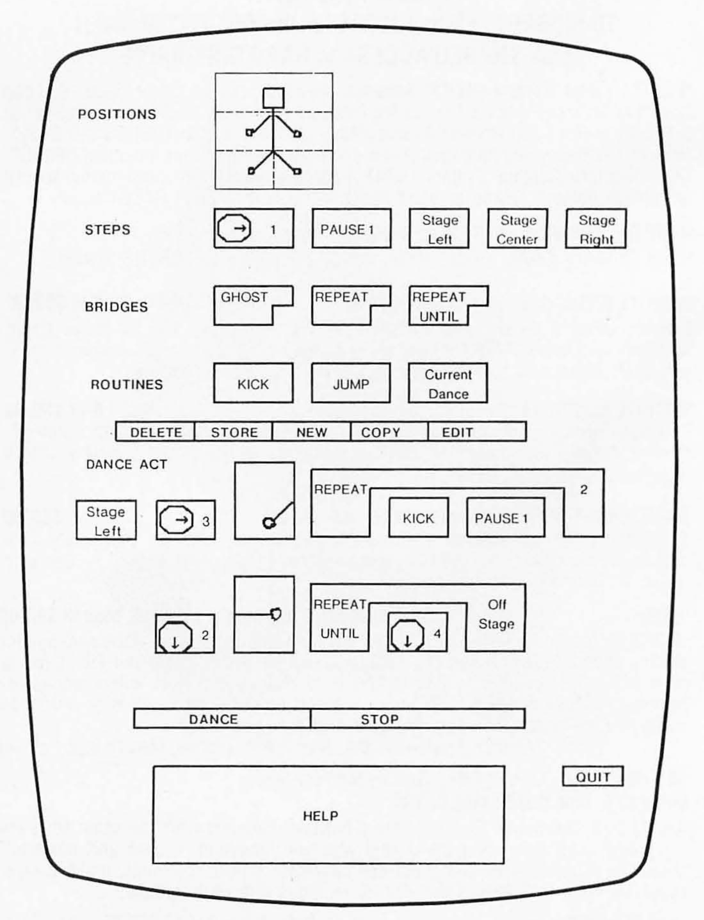
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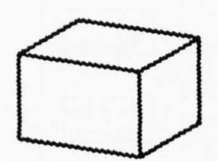
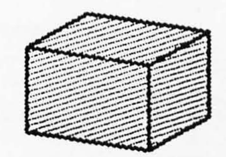


Text continued from page 362:
changed appropriately. A Turtle Dance Act that is akin to the Stick Person Dance Act shown in the first variation appears in figure 9. The animation for this Dance Act consists of the sequence of views shown in figure 10.

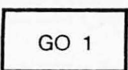
Third Variation: Boxes

The dancer might be a simple geometrical shape. The dancing needn't be subdivided, but replacement parts for the whole figure might be available.

For example, the user might create the following replacement parts:

Suppose the initial dance is set with the dancer moving toward the right. A possible Dance Act is shown in figure 11, where next HEX is defined as:



The ghost is used to leave a trace of the box after each step. Each step unit was presumably scaled by the user to be the size of the box so that no overlapping occurs. At the end of this act the screen would look like figure 12.

Another possible geometric design comes from the building blocks shown in figure 13. If the dance act is defined as shown in figure 14, then at the end of the dance the screen will look like figure 15. When a figure of one color is superimposed on a figure of another color, the underlying figure disappears.

Fourth Variation: The Degenerate Turtle

The Dance Kit can be used to do conventional Turtle geometry (see reference 6) by allowing the figure to degenerate to a point (no replacement parts need apply) and defining a scale such that GO 1 means to go to the next point on the screen.

Dancing School

The Dance Kit is one example from a variety of kits and ideas for kits that we have entertained and that have entertained us. One of our major concerns is to create an environment in which the design of interesting and imaginative educational materials will be fostered, and we believe that the Smalltalk-80 system will make it easier to create such kits.

We have given much thought to some necessary characteristics of a framework for a Dance (or any other) Kit. We suggest that certain services always be present on the screen. For example, a help system is of supreme importance. We have provided an indication of the help system we would incorporate into the Dance Kit. The TRIP system for animating algebra word problems (see reference 5) provides such a complete HELP facility that even fearful users need be told only how to use the pointing device in order to control all the functionality of the system. Other possibilities for services include a LIBRARY, a GUIDE to other activities that might be appropriate, and a facility that allows users to enter sug-

View	Comment	Dance Element	
	begin	Stage Left	
	move over 3	3	
	make certain leg is down		
	begin KICK leg up	a KICK Element	first REPEAT
	leg down	a KICK Element	
	leg up	a KICK Element	
	leg down	a KICK Element	
	pause	PAUSE 1	
	leg up	a KICK Element	second REPEAT
	leg down	a KICK Element	
	leg up	a KICK Element	
	leg down	a KICK Element	
	pause	PAUSE 1	
	move down 2	2	
	raise arm		
	move down 4	4	REPEAT UNTIL Off Stage
	move down 4	4	
	etc		

Figure 6: *Execution of the dance given in figure 5f.*

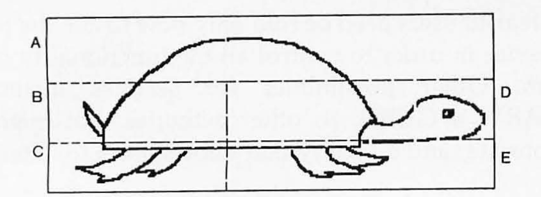


Figure 7: *A basic drawing of a big turtle that can be animated.*

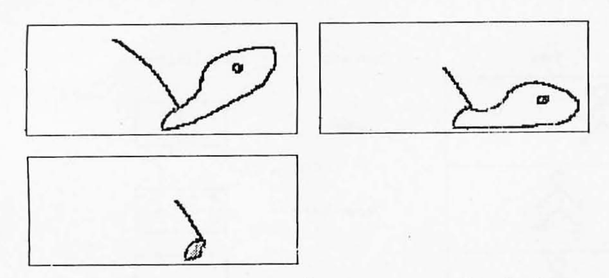


Figure 8: *Example alternate replacement parts for the big turtle.*

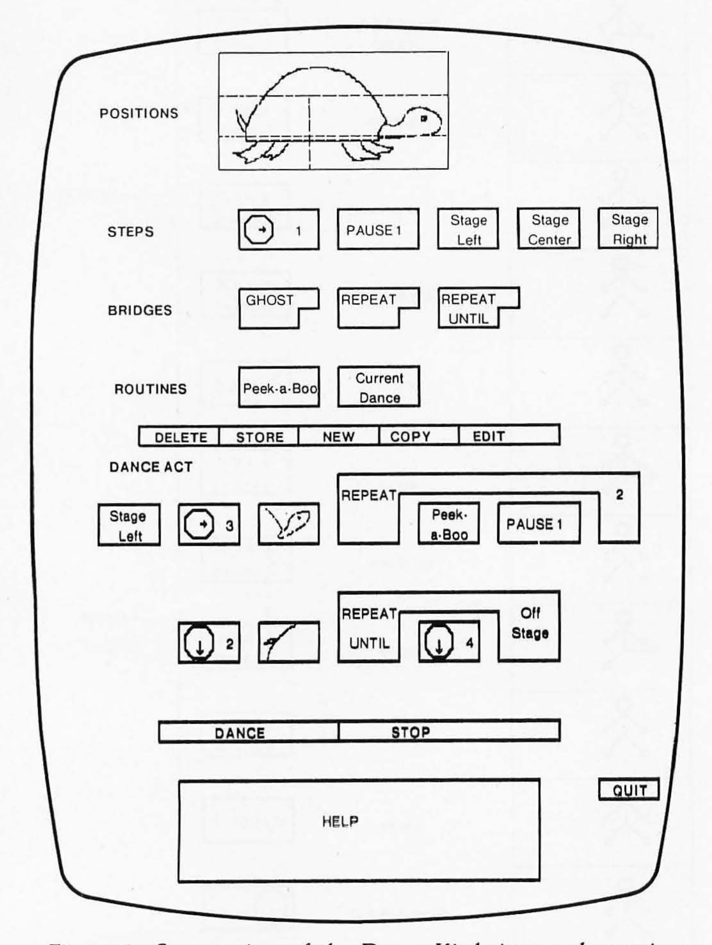


Figure 9: *Screen view of the Dance Kit being used to animate the big turtle.*

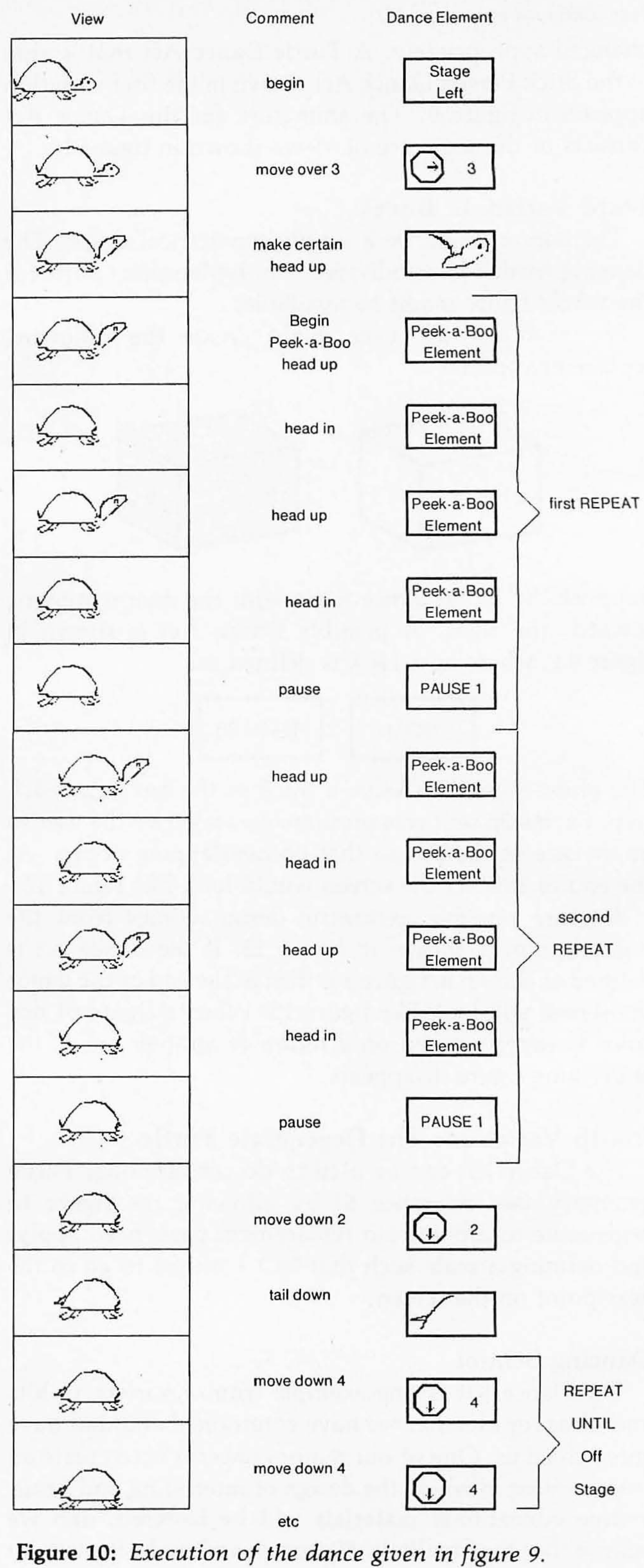


Figure 10: *Execution of the dance given in figure 9.*

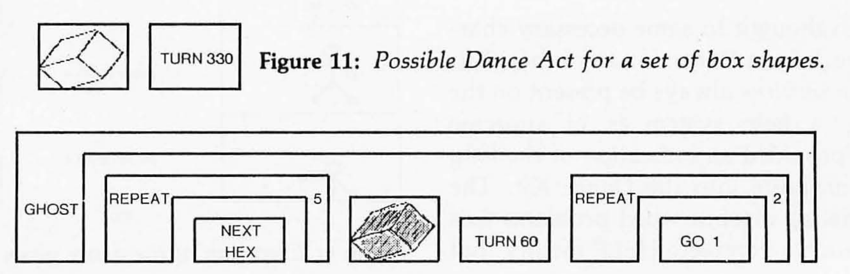


Figure 11: *Possible Dance Act for a set of box shapes.*

gestions and other feedback for the instructor (ie: a GRIPE).

We have also imagined a Dance Kit in a computerless classroom. The idea that computer-based activities should have concrete analogues, especially for young children, has been well received in the experience of the MIT LOGO group. We would use the children as the figures in the dances and create the Dance Act instructions and routines on paper or a blackboard or.... Of course if we want to leave ghosts, we will need to enlist the services of more than one child.

In this mode of use of the Dance Kit we are fond of imagining children as the design elements of the seven possible friezes shown in figure 16; each frieze is characterized by the group of transformations or symmetries that

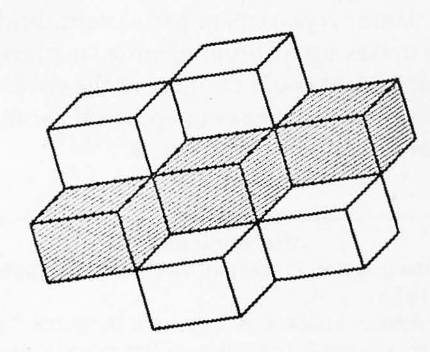


Figure 12: *Drawing made by the Dance Act of figure 11.*



Figure 13: *A basic drawing of some geometric designs that can be used by the Dance Kit.*

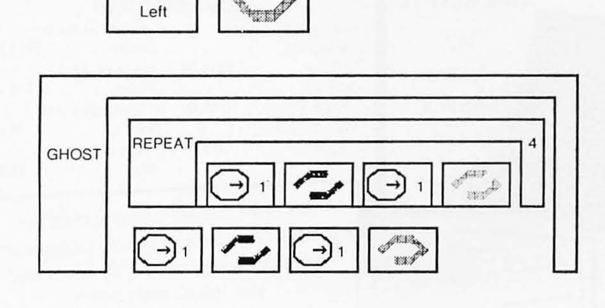


Figure 14: *Possible Dance Act for the set of geometric designs.*

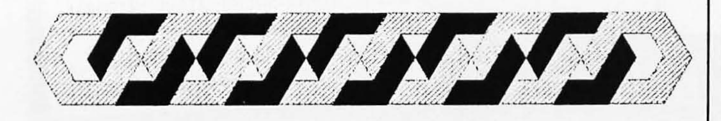


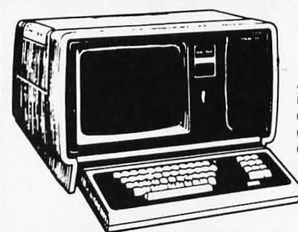
Figure 15: *A drawing made by the Dance Act of figure 14.*

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Figure 16: *Frieze patterns of stick men. By combining a basic pattern and its variations, many frieze patterns can be made.*

preserve them. (A symmetry is a one-to-one transformation that preserves distance.) The basic symmetries are translations, rotations, and reflections. We envision the children casting their shadows to form the patterns—or perhaps even lying on the floor. (Of course, mathematical friezes are like lines—infinitely long—but we can enjoy thinking about finite pieces.)

Frieze patterns might look like those in figure 16. However, we will leave the Dance Acts for the frieze patterns as an exercise for the reader.

The Dance Kit can be thought of as a forum for learning introductory programming concepts. A curriculum developer would create a dancer and replacement parts that are of interest to the student; the developer would also select steps, bridges, and initial (sub-)routines that support recommended or assigned exercises. The combination of dancer replacement parts, steps, bridges, and subroutines makes up a "programming language." Alternatively, the student could do more of the creation of the language. The Dance Kit has our approval because of this possibility of dual and flexible use.■

References

1. Bricklin, Dan and Bob Frankston. VisiCalc™ Computer Software Program, 1979.
2. Goldberg, Adele. "Educational Uses of a Dynabook." *Computers in Education*, Volume 3. Great Britain: Pergamon Press Ltd, 1979, pages 247 through 266.
3. Goldberg, Adele and Alan Kay. *Teaching Smalltalk*. Technical Report SSL 77-2, Xerox Palo Alto Research Center, 1977.
4. Goldberg, Adele, Dave Robson, and Dan Ingalls. *Smalltalk-80: The Language and Its Implementation* and *Smalltalk-80: The Interactive Programming Environment* (forthcoming).
5. Gould, Laura and William Finzer. "A Study of TRIP: A Computer System for Animating Time-Rate-Distance Problems." *Proceedings of the IFIP Third World Conference on Computers in Education (WCCE-81)*. July 1981, Lausanne, Switzerland.
6. Papert, Seymour. *Mindstorms: Children, Computers, and Powerful Ideas*. New York: Basic Books, 1980.



ToolBox: A Smalltalk Illustration System

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Learning Research Group
Xerox Palo Alto Research Center
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Palo Alto CA 94304

Computer art is usually thought of as linear, geometric, and repetitious. The Smalltalk group at the Xerox Palo Alto Research Center has been exploring the potential image-making capabilities of the computer-powered display medium for almost ten years. We have investigated the idea of using the computer and its associated display as an art medium for a user/artist to create visual material. We allow the mixture of an artist's freehand sketches with structured commands for manipulating graphic forms. This approach can be contrasted with the more traditional approach where the machine is programmed to "draw," usually with lines, some visual image on the display screen. Figure 1 is a typical computer-generated pattern in which symmetrically ordered lines form an illusion of spherical volume.

This article reports on one of our developments in the area of computer-assisted image creation. ToolBox is a drawing system designed for general-purpose, interactive image creation and editing. ToolBox was designed jointly by artist William Bowman and computer scientist Bob Flegal to explore graphic specialization within the computer-powered display medium. We were interested in determining the areas within the visual and graphic arts for which the computer-powered display medium is a particularly suitable and efficient graphic tool. To do so we investigated possible tools, techniques, and image-making capabilities of this new medium. The underlying implication (and intention) of this approach is a new role in professional graphics: that of the illustrator/artist who creates images with computer machine tools rather than with conventional hand tools.

ToolBox is a graphics system designed for general-purpose, interactive image creation and editing.

The ToolBox system receives input from the user/artist from a graphics tablet and keyboard and modifies the screen image based on his/her actions. The computer program does not generate the image from a set of programmed drawing instructions. For example, to specify a straight-edge line, the artist need only specify the two end points of the line with the graphics tablet and the program completes the line. This is in contrast to methods where a "pen" is programmed with up, down, and draw commands with coordinates as arguments. This idea is illustrated in figure 2.

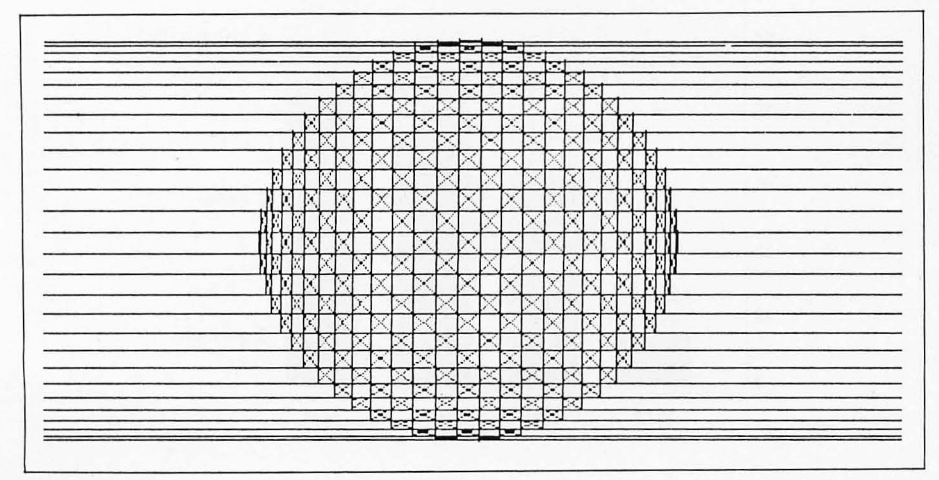


Figure 1: *A typical computer-generated geometric design in which symmetrically ordered lines form an illusion of spherical volume.*

System Description

ToolBox consists of a coordinated set of graphic tools that provide a wide range of form construction options for use in testing machine illustration concepts. Five fundamental tool functions comprise the basic graphical form vocabulary. Each of these tools can be modified in its use by one or more of four sets of variables that can affect its form source, color tone, grid spacing, and functional mode. Brief descriptions of the

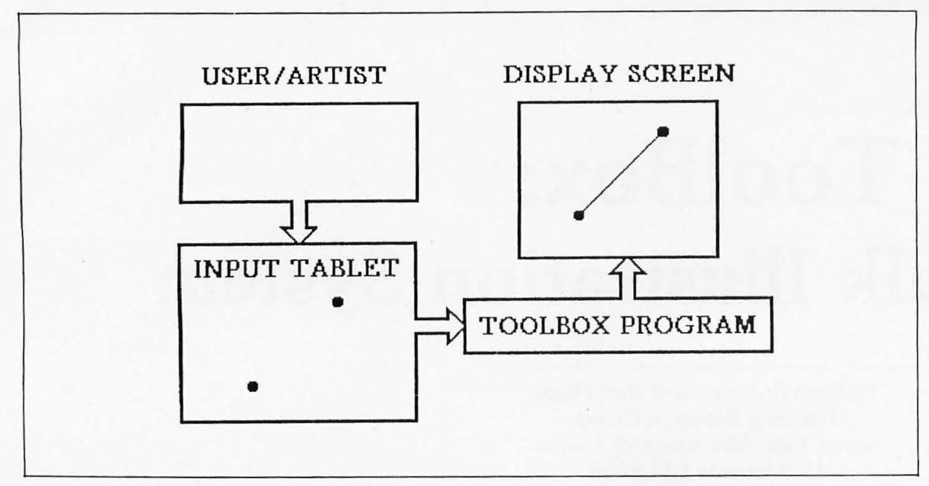


Figure 2: *Modification of the ToolBox screen image based on user/artist input. The computer assists in drawing a line after the artist has entered end points on a graphics tablet.*

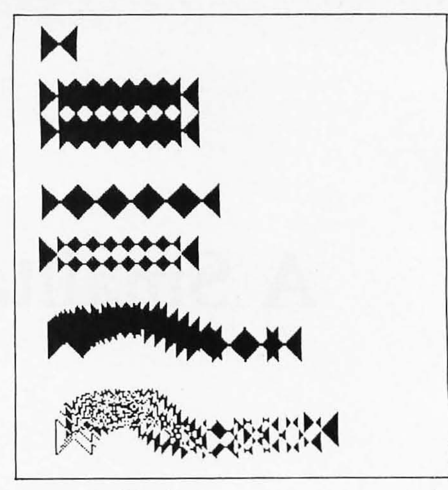


Figure 3: *ToolBox variations on a single form source—two triangles.*

tools and the variables affecting them follow.

Select Form allows the user/artist to select a rectilinear-shaped picture from the display screen as the form source. The form selected can be thought of as a brush which the other five tools use as their source picture. The artist can create a form source using any of the tools available in the ToolBox system, from Smalltalk graphic commands, from the Smalltalk text editor, or from a library of form sources.

The following are ToolBox tool functions:

- COPY enables continuous individual copies of the form source onto the display screen. This can be thought of as painting on the display screen using a brush (the form source)
- DRAW enables freehand line drawing or sketching by connecting form source copies with line segments
- ARC enables curve construction (using spline functions)
- BLOCK enables solid rectangles to be formed
- LINE enables straight-line construction between two points

Grid spaces modulate the tools to function on specifiable horizontal and vertical grid lines.

Color tones allow creation of form in black, white, or one of the four intermediate grays (spatial-halftones).

There are three *modes* affecting the copying of source forms onto the display: *store, or,* and *xor.* We called these modes "over," "under," and "reverse."

Art Examples

Figure 3 shows some of the visual effects that are possible with a single form source—two triangles. Since each form source can have five tools, five griddings, six colors, and three modes, the number of possible pictorial effects is staggering.

The display screen upon which the pictures in this article were made is 606 by 808 dots, and each dot is either black or white (no gray scale). The display is refreshed out of the computer's main memory. Thus, to turn a display dot black or white, 1 or 0 is written into memory.

During the programming and development of the ToolBox system, a series of image-making experiments were conducted, both as active input to the evolving design of the system and as a preliminary test of its capabilities. The main purpose of these experiments was to explore the potential of the machine tools for enabling

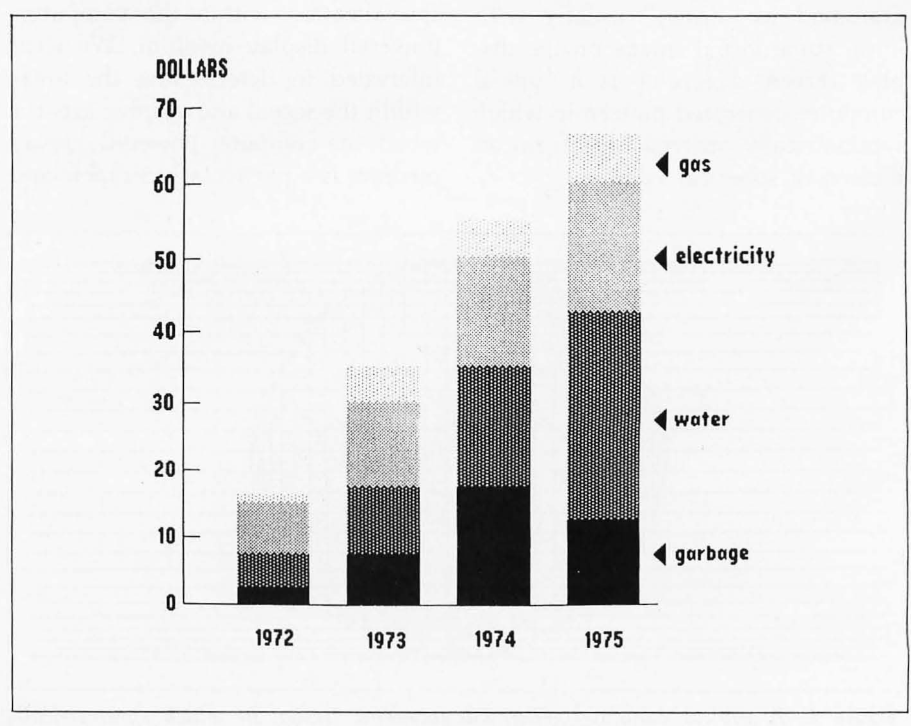


Figure 4: *A bar chart designed by William Bowman.*

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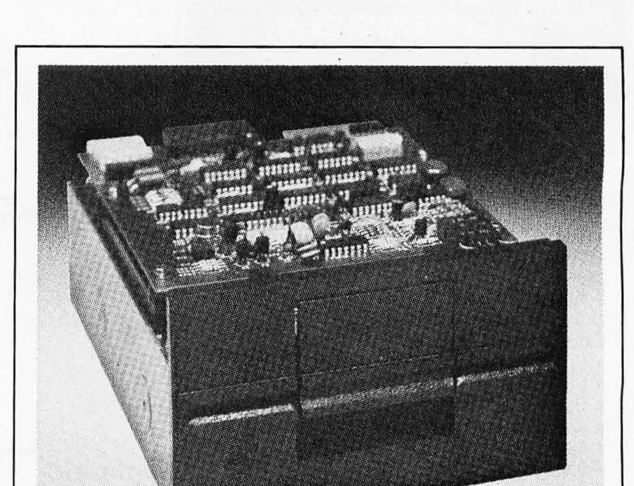
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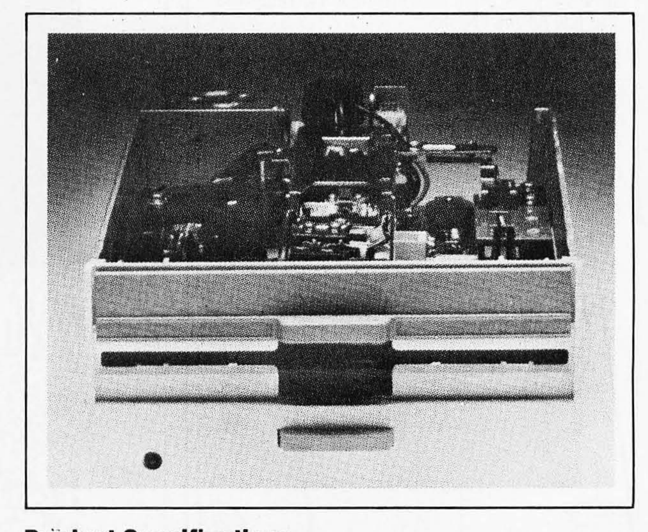
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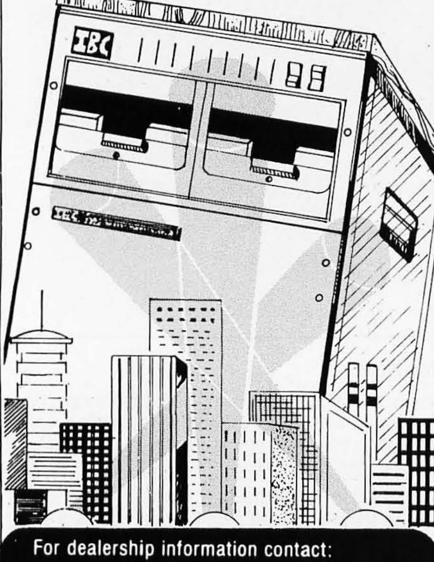
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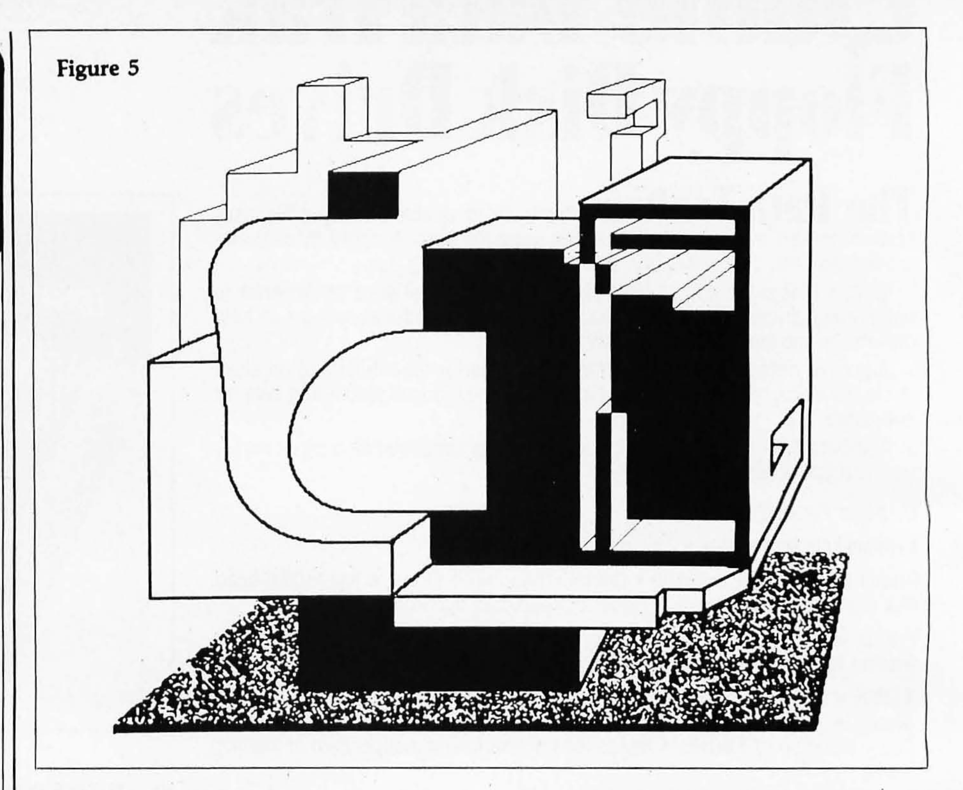
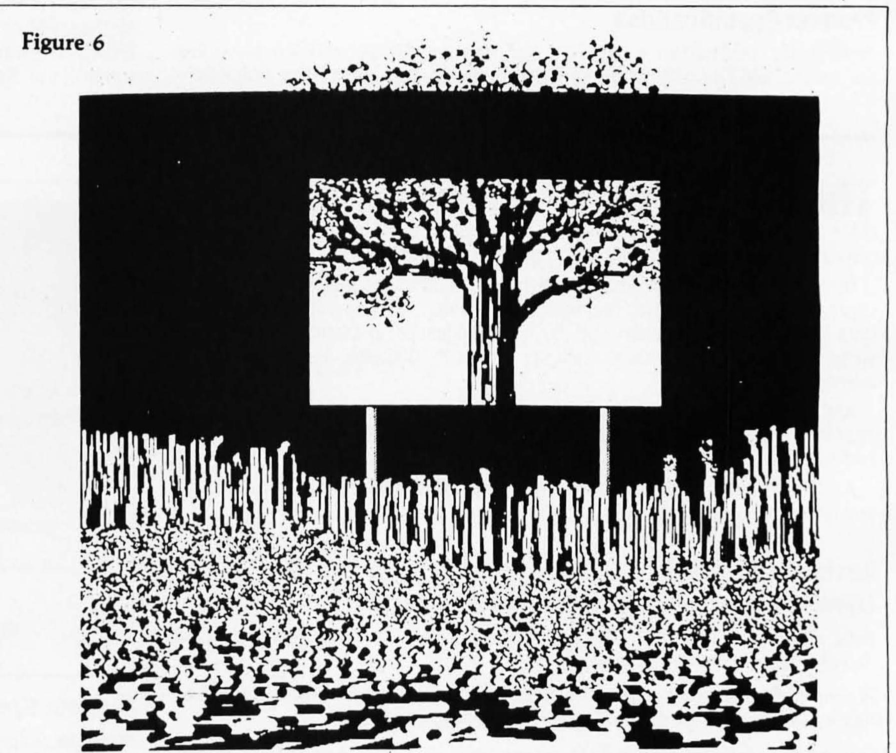


Figure 6



Figures 5, 6, 7, 8: *These four illustrations by Bowman were created using the ToolBox graphics system.*

a variety of graphic strategies for image design and execution. Some of these strategies resembled conventional graphic techniques; however, most of them turned out to be unique to the machine medium.

The remainder of this article consists of pictures that grew out of these early experiments. They are intended as a demonstration of the range and depth of graphic language effects that can be achieved with the ToolBox system.

Figure 4 is a simple bar chart. This figure made heavy use of the BLOCK tool and several grid settings. The

Figure 7

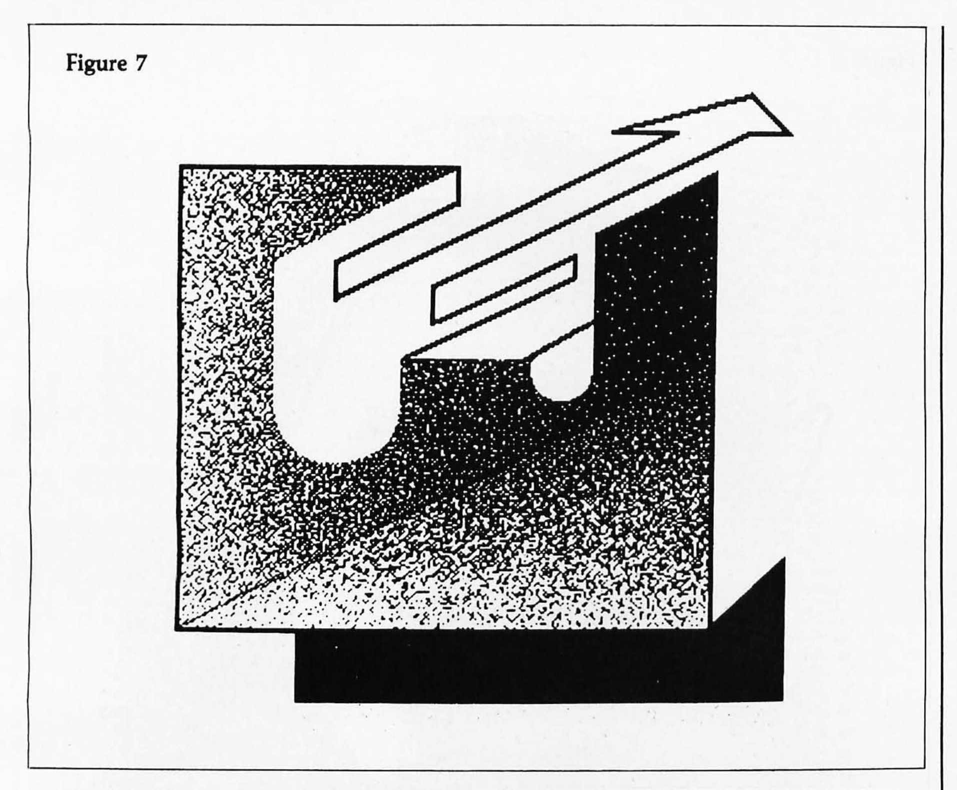


Figure 8

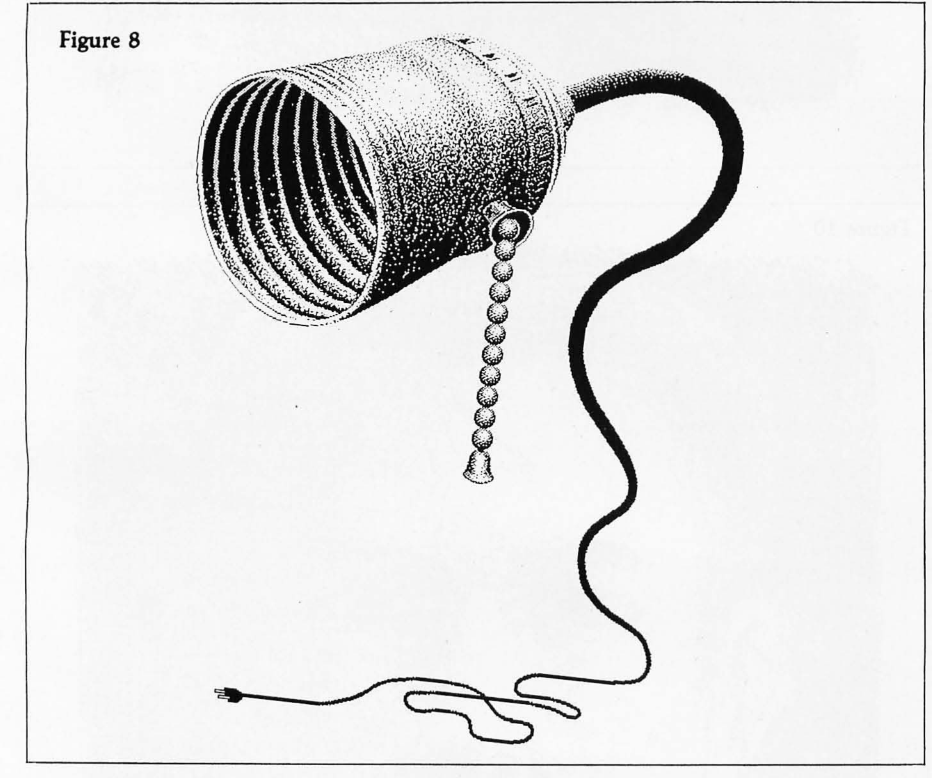


illustration was done in a very short amount of time compared to the amount of time it would take to draw a simple bar chart using conventional media. The ToolBox system is particularly effective for images involving horizontal and vertical elements. (Figures 4, 5, 6, 7, and 8 were executed by William Bowman.)

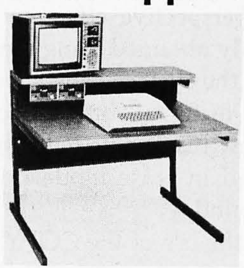
The BLOCK, LINE, and CURVE tools were heavily used in figure 5. Note the texturing at the bottom of the illustration; it was created using the COPY tool in reverse mode with the color variable set to black.

In figure 6, the COPY tool in

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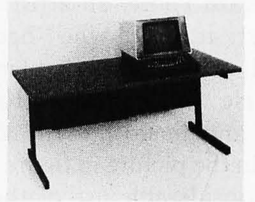
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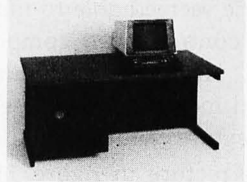
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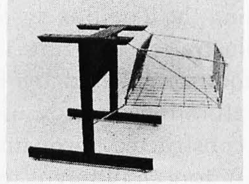
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reverse mode was used to create the effects in the bottom half of the image and for the leaves and the bark on the tree.

The perspective effect in figure 7 was easily obtained using the grid settings in the system. The shading was created using a "brush" containing just a few black dots with the COPY tool used in erase mode on a black background.

Note the use of the COPY tool and grid settings to construct the chain on the socket in figure 8. The ToolBox system proved particularly effective for rapid construction of repeated patterns.

The next four pictures were done by Howard Foote, an artist and college art teacher who had never worked on a computer system or terminal. He was contracted to use the system and push it to its graphical limits. In the picture in figure 9, Foote made considerable use of the COPY tool and DRAW tool.

In the picture in figure 10, Foote was able to represent his subject with remarkable loyalty to physical realities when he wanted to and at the same time seemed able to maintain a flexible control over compositional features. His form vocabulary was wide and included a rich use of line, shape, texture, and tonal value.

In the picture in figure 11, Foote made considerable use of the DRAW tool to achieve a free and open effect. Geometrical forms and exact technical mastery of fine detail were the only major areas of pictorial interest with which he did not choose to deal when using the ToolBox system.

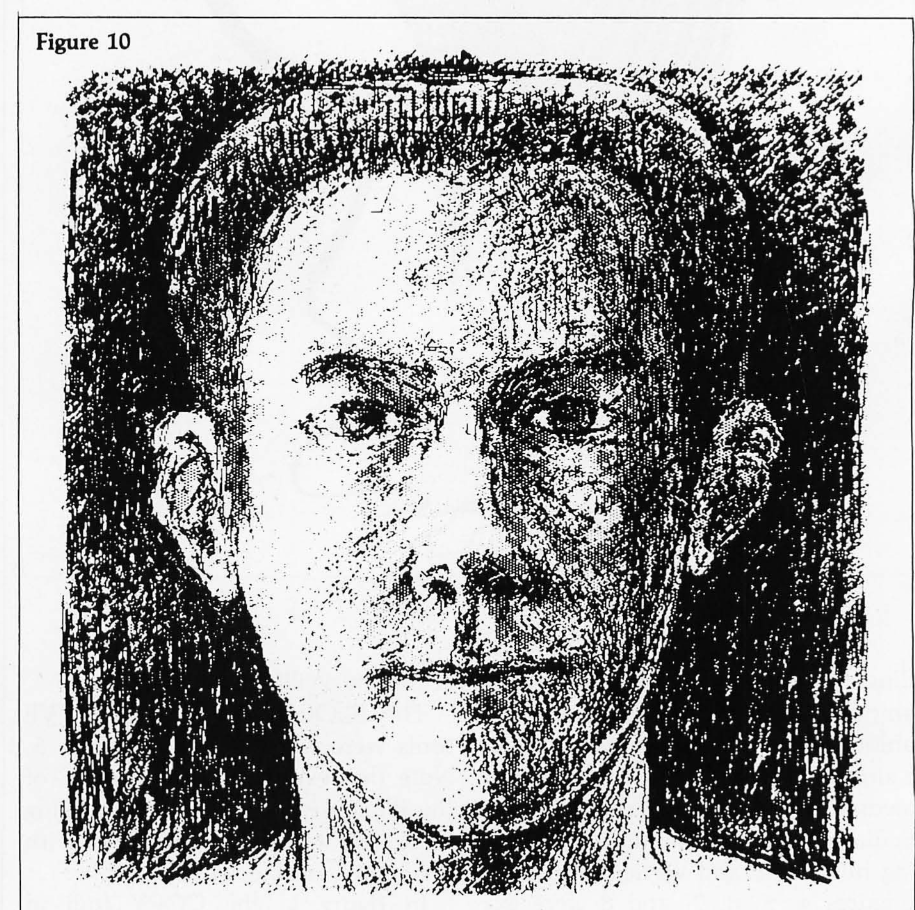
The illustration in figure 12 shows a technique often used by Foote: a spatial-saturation strategy using personally constructed form units with the COPY tool in different tones and modes.

The final illustration, figure 13, was done by Bob Flegal. The motifs in the border were taken from North

Figure 9



Figure 10



Figures 9, 10, 11, 12: *The drawings in these four figures were done by Howard Foote, an artist and college art teacher who was contracted to use the ToolBox system and to push it to its graphical limits.*

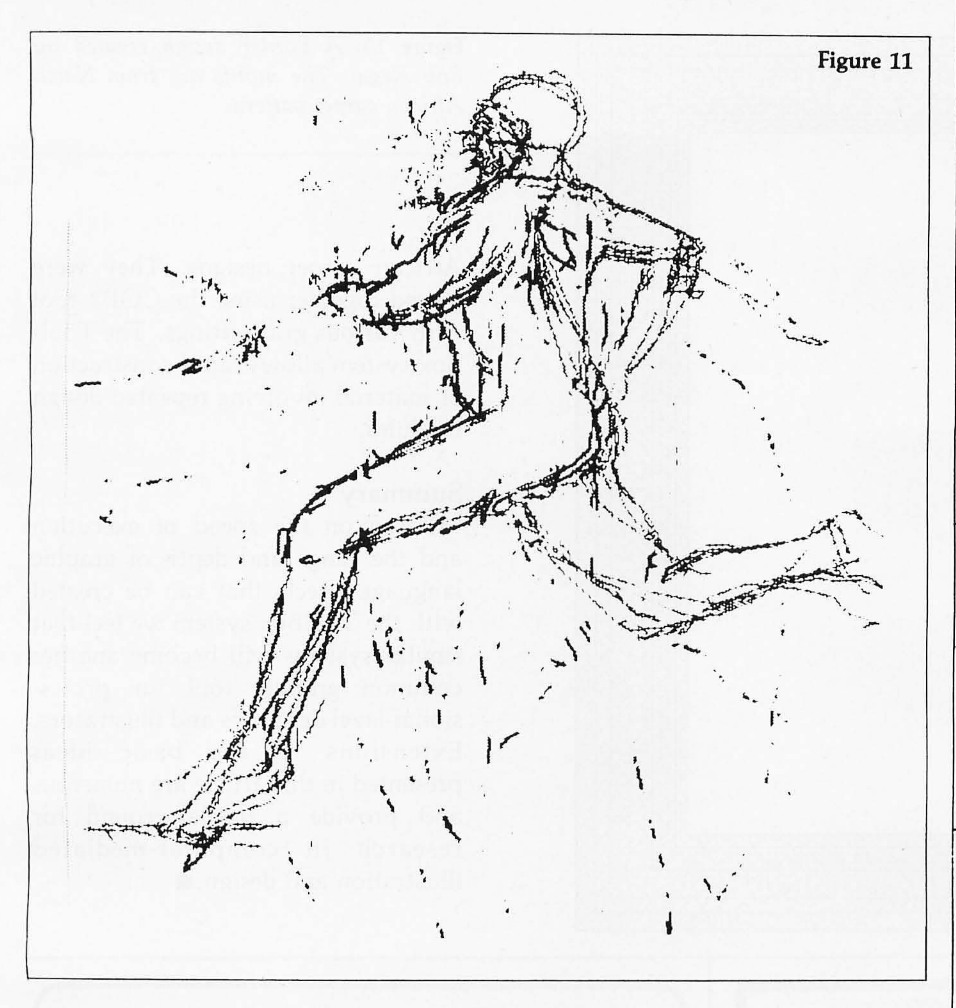


Figure 11

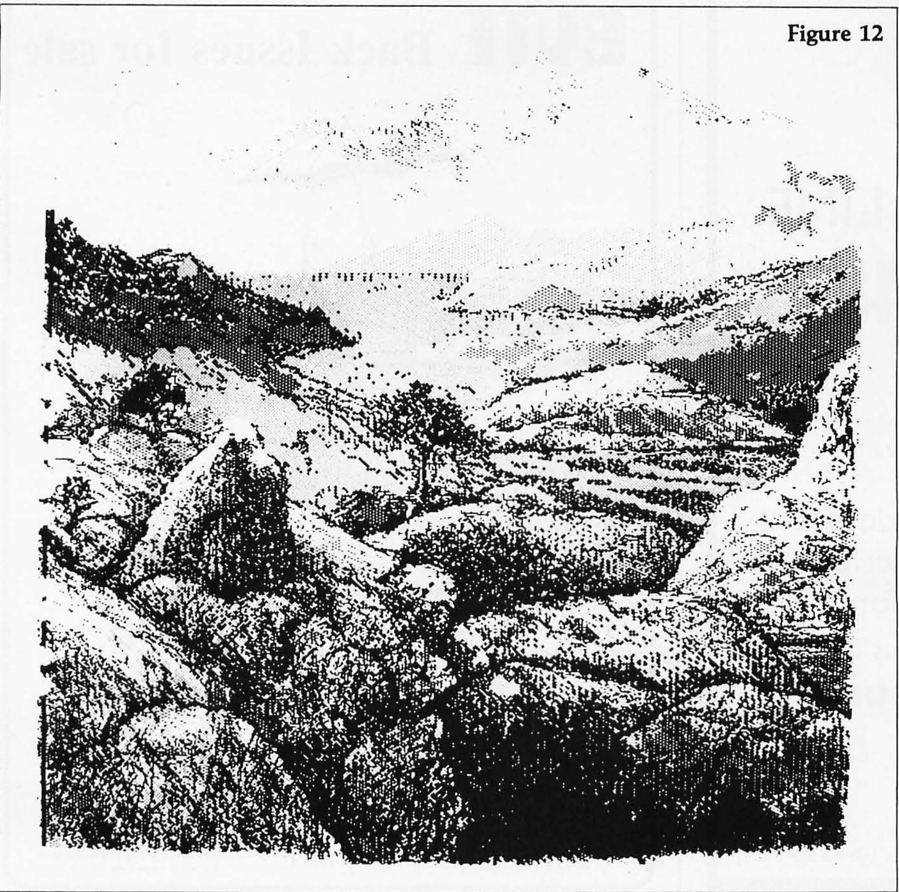


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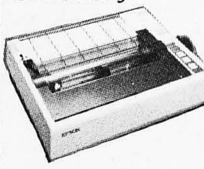
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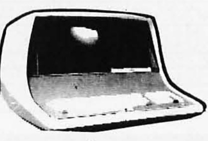
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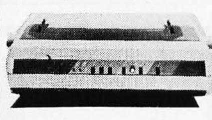


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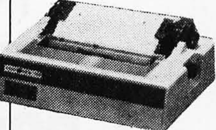
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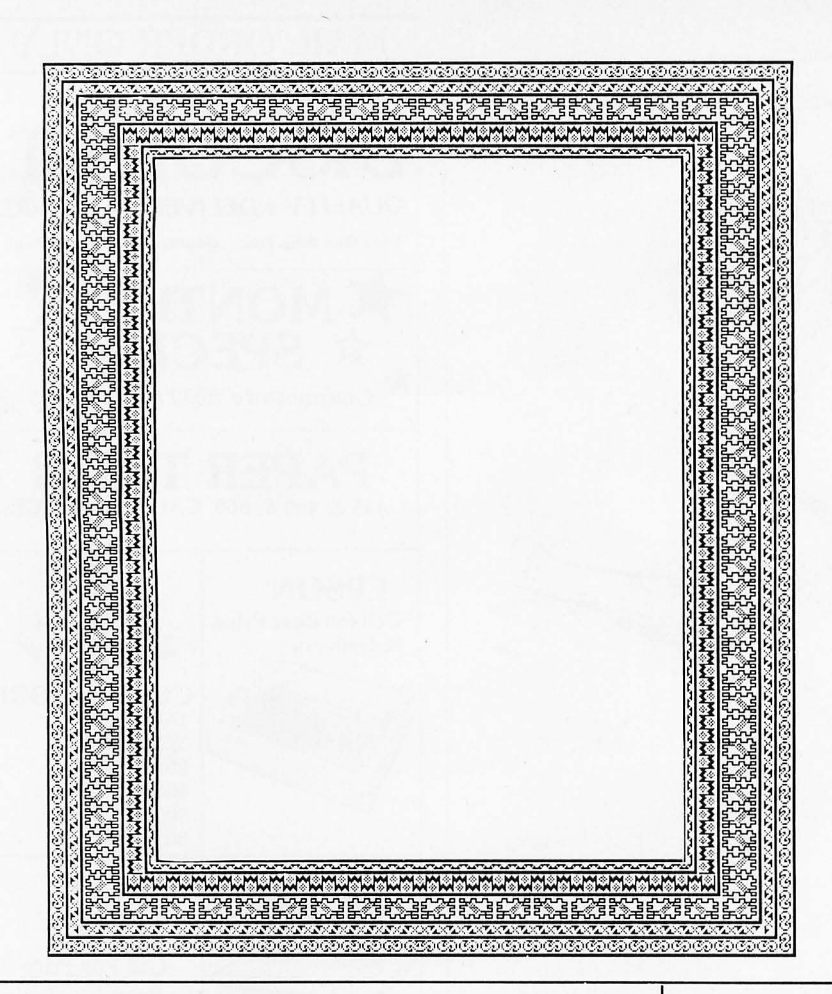


Figure 13: *A border design created by Bob Flegal. The motifs are from North African carpet patterns.*

African carpet designs. They were pieced together using the COPY tool with various grid settings. The ToolBox system allows rapid construction of material involving repeated design modules.

Summary

Based on the speed of execution and the range and depth of graphic language effects that can be created with the ToolBox system we feel that similar systems will become another common graphic tool for professional-level designers and illustrators. Extensions of the basic ideas presented in this article are numerous and provide a fertile ground for research in computer-mediated illustration and design. ■

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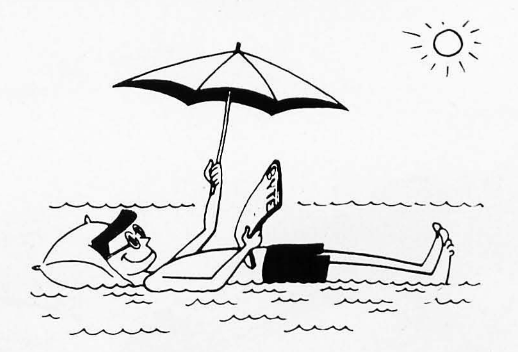
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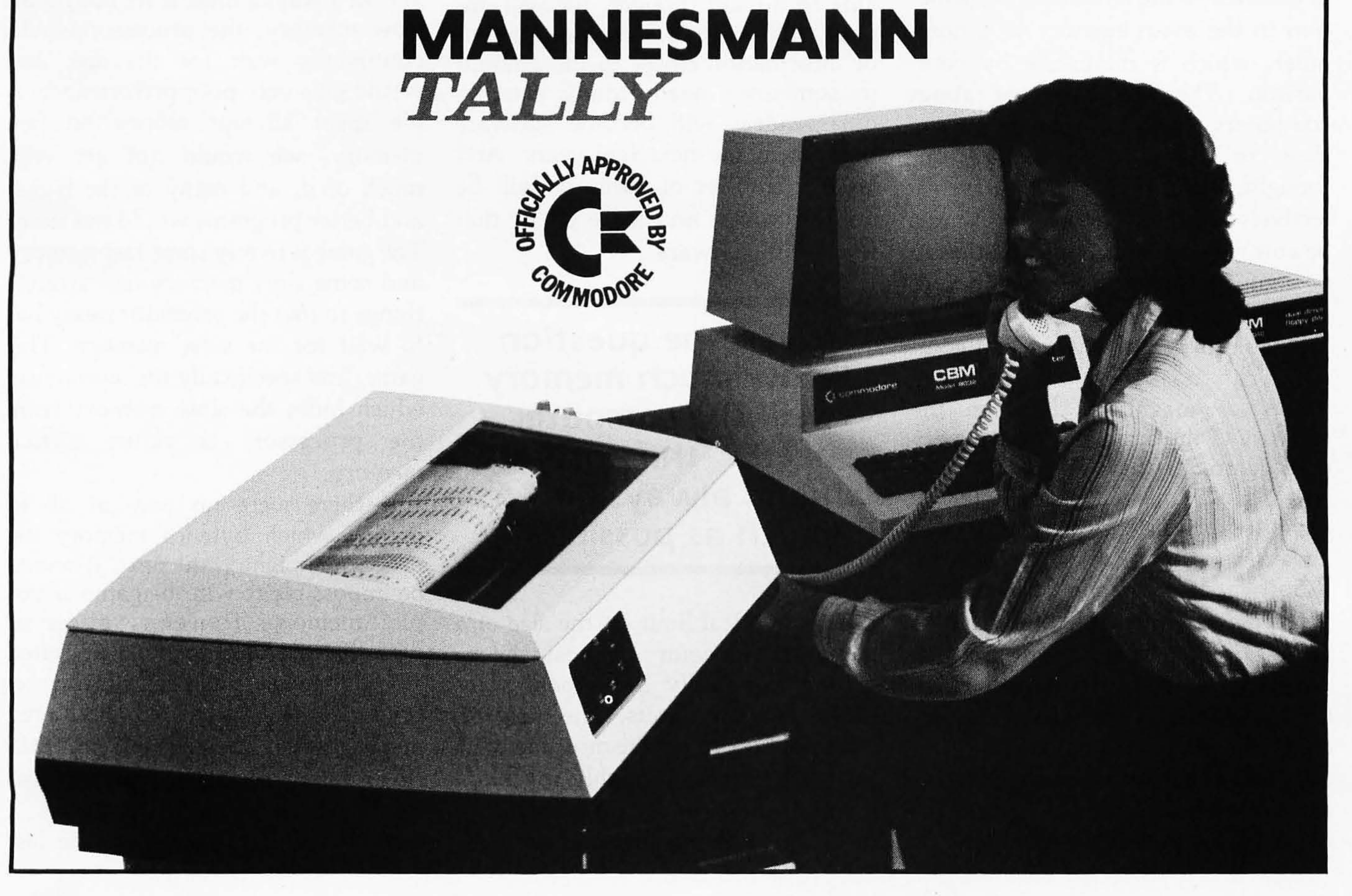
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Virtual Memory for an Object-Oriented Language

Ted Kaehler
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The amount of information in a person's brain is truly vast; even the amount accessed in the course of a few hours of thought is vast. This is in contrast to the amount of information in the main memory of a computer, which is minuscule by comparison. The exciting thing about computers, though, is that we can use them to extend and enhance our thought. If a computer is to serve effectively as an aid to thought, it must be able to hold enough information to be useful. However, the memory of the largest computer today is so small that it severely limits what that computer can do. There are so many orders of magnitude between the capacity of the brain and the capacity of a computer that given the question "How much memory will the computer need?" the answer should always be "As much as possible."

Software for personal computers is just crossing a threshold of usefulness and flexibility. There are tasks, such as revising a draft of a paper, which are tremendously easier to do with a computer than without. Once you have edited with a computer, it seems absurd to edit by hand. The *number* of tasks for which the computer is essential is growing rapidly, causing a very sharp rise in the demand for storage in each personal computing system. As we design more useful aids to human thought, we will immediately want to access an amount of information closer to the amount in someone's head. Many extraordinary ideas will become software realities in the next few years. And large quantities of memory will be needed to run and store all of that wonderful software.

Given the question "How much memory will the computer need?" the answer should always be "As much as possible."

The practical limit on the size of a computer's memory is cost. Every project, especially a personal computer, has cost limits. The question becomes how to get the most memory for the least cost. Roughly speaking, memory falls into two categories: fast, expensive memory and slow, inexpensive memory. *Main memory* and *core* are common names for the fast, semiconductor memory. The slow memory, *secondary memory*, is almost always a disk. If we bought all slow memory, the processor would continually wait for the disk and would give very poor performance. If we spent all our money on fast memory, we would not get very much of it, and many of the bigger and better programs would not fit in. The game is to buy some fast memory and some slow memory and arrange things so that the processor rarely has to wait for the slow memory. This game, and specifically the mechanism which hides the slow memory from the processor, is called *virtual memory*.

If there were no way at all to predict which byte of memory the processor might want next, it would be impossible to win the game of virtual memory. However, pieces of data that are used together are often stored together, and program instructions tend to be executed and stored in a sequence. The principle of *locality of reference* states that the processor is most likely to access a memory location very near the last

one it accessed (see reference 2 at the end of this article). The game of virtual memory is based on a trick: when the processor starts to ask for bytes from a block of code or data, it should move that code or data into the fast memory. If the processor continues to access that information, all of the accesses will be to fast memory. When the program moves on to a new activity, it may again be forced to get its information from the slow memory. To win the game, a virtual memory must maintain a situation where most of the processor's accesses are to the fast memory. If the strategy fails and the processor often wants data from the slow memory, the entire system will run very slowly.

The act of moving programs or data between the two kinds of memory is called *swapping* (see figure 1). The program that the user is running may or may not control the swapping explicitly. Overlays are large groups of subroutines that are moved to and from the disk under control of the user program. In an *automatic virtual memory*, however, the user program is unaware that swapping is occurring. The programmer does not specify how the program should be divided up into pieces or when swapping should occur.

In certain cases, letting the programmer control swapping directly can result in good performance. However, the virtual memory game is very complex and is played very quickly inside the computer. We believe that the programmer should not be burdened with deciding what part of the data to swap and when to do it. Asking the programmer to instruct the virtual memory is like asking a race car designer to write down, for the driver, exactly how to move the steering wheel in some future race.

In this article, we first look at a common type of automatic virtual memory called *paging*. We then introduce a new type of virtual

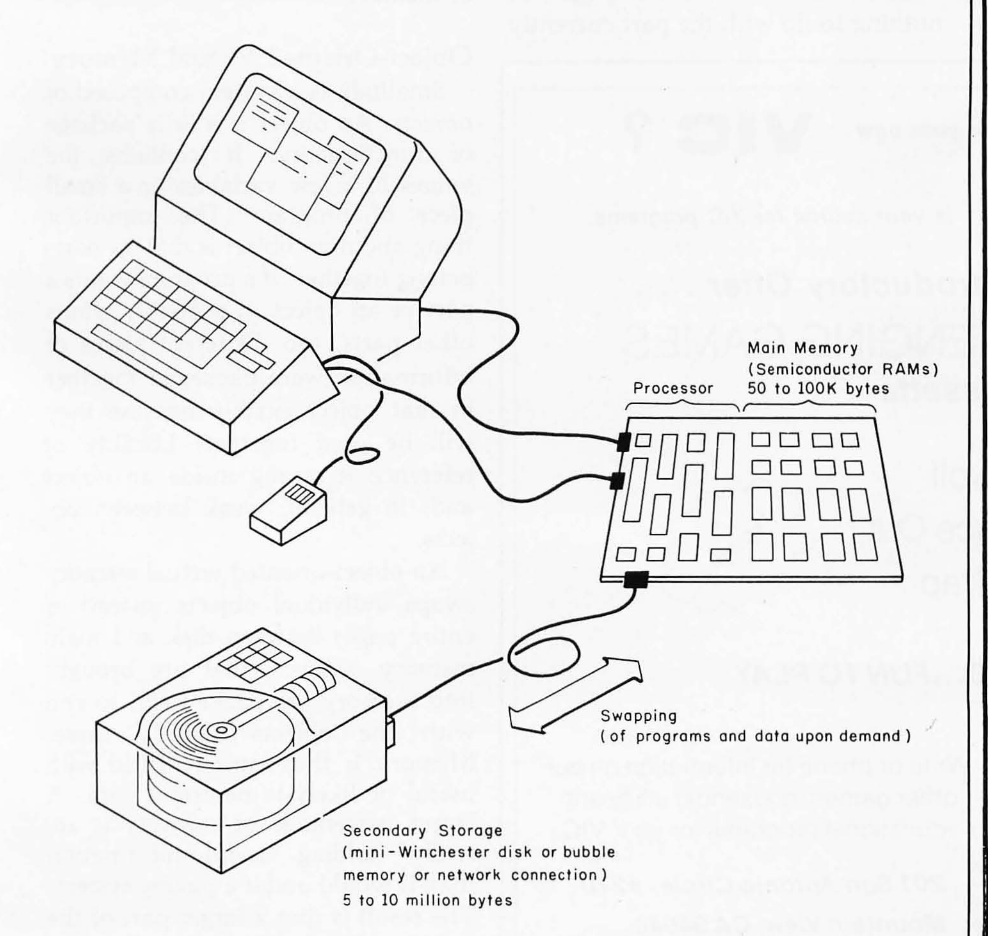


Figure 1: *Main memory, secondary memory, and swapping combine to form a virtual machine that seems to have more memory.*

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memory that takes advantage of its knowledge of objects. We describe in detail a specific object-oriented virtual memory for the Smalltalk-76 system and explain how it plays the virtual memory game better than a paging system.

Paging

The most common kind of automatic virtual memory is called paging. In paging, the program is cut up arbitrarily into pieces. Each piece is called a *page* and contains the same number of bytes as every other page—say, 512. There are many more pages than will fit into main memory at once, so most of them stay on the disk. The processor knows only about byte addresses in one large address space called the *virtual address space*. Every time the processor accesses a byte, the address of the byte is checked. The high-order bits of the address tell which page contains that byte. (The low-order bits tell which byte within the page.) If that page is not in main memory, the user program stops. The virtual memory program starts up, finds an old page, moves it to the disk, and brings the desired page into memory in its place. (We will use the term "memory" to refer to the fast, main memory only.) The act of discovering that a page is needed from the disk and bringing it into memory is called a *page fault*.

An advantage of paging is that it works regardless of the contents of the pages. The mechanism needed to determine whether a given page is in memory is simple. Many computers have special hardware to speed up the translation between an address in the virtual space and a page in memory.

There are problems with paging, however. If the program needs a particular byte, the entire page surrounding that byte must be brought into memory. If no other bytes on that page are useful at the moment, a large amount of main memory is wasted. Since programs are cut up arbitrarily into pages in the first place, it is common that the rest of the page has nothing to do with the part currently wanted. Sometimes a significant fraction of memory is taken up by pages from which the processor wants only a few bytes (see figure 2). These pages crowd out pages containing other parts of the program, causing many pages to be swapped to run the rest of the program. The many accesses to slow, secondary memory cause the whole system to be slow.

Another problem with paging is that every address of a byte or a word must be a long address. When an object-oriented language is built on a paging system, a pointer to an object is typically the address of the first word of the object. Every pointer must be capable of reaching any word in the entire virtual space, and each one must have enough bits to span the space. Pointers comprise a large fraction of many programs and data structures. If they could be shorter, more of the program could be packed into one page in memory and the entire program would take fewer pages of memory.

Object-Oriented Virtual Memory

Smalltalk is a system composed of *objects*. An object is a little package of functionality. It contains the values of a few variables or a small piece of program. The important thing about an object is that its parts belong together. If a program wants a part of an object, it probably wants other parts, too. Different pieces of information were packaged together in that object exactly because they will be used together. Locality of reference is strong inside an object and, in general, weak between objects.

An object-oriented virtual memory swaps individual objects instead of entire pages between disk and main memory. Objects that are brought into memory are packed end to end with the objects already there. Memory is thus entirely filled with useful or likely-to-be-useful data. A larger percentage of memory is actually holding useful information than it would under a paging system. The result is that a larger part of the program can fit into memory at once.

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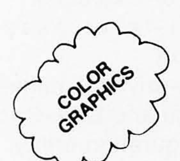


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jects, however. Objects are generally smaller than pages, and there are a lot of them in memory at once. The virtual memory program must keep track of which object is in which place in the memory, and it must be able to find out where each object came from on the disk. Managing individual objects is more complicated than managing pages, but the advantage of packing main memory with useful objects makes up for the time spent managing the objects.

By object-oriented virtual memory, we mean a system that swaps objects which have meaning in the high-level language and which are typically small. Segments in the B5500 (reference 4) and objects in HYDRA (reference 5), while being the units of swapping in their systems, are large. These "objects" require tens or hundreds of bytes of overhead information each. An object-oriented virtual memory, in our sense, gives an object the same swapping freedom as a segment and shrinks the overhead to a few bytes per object.

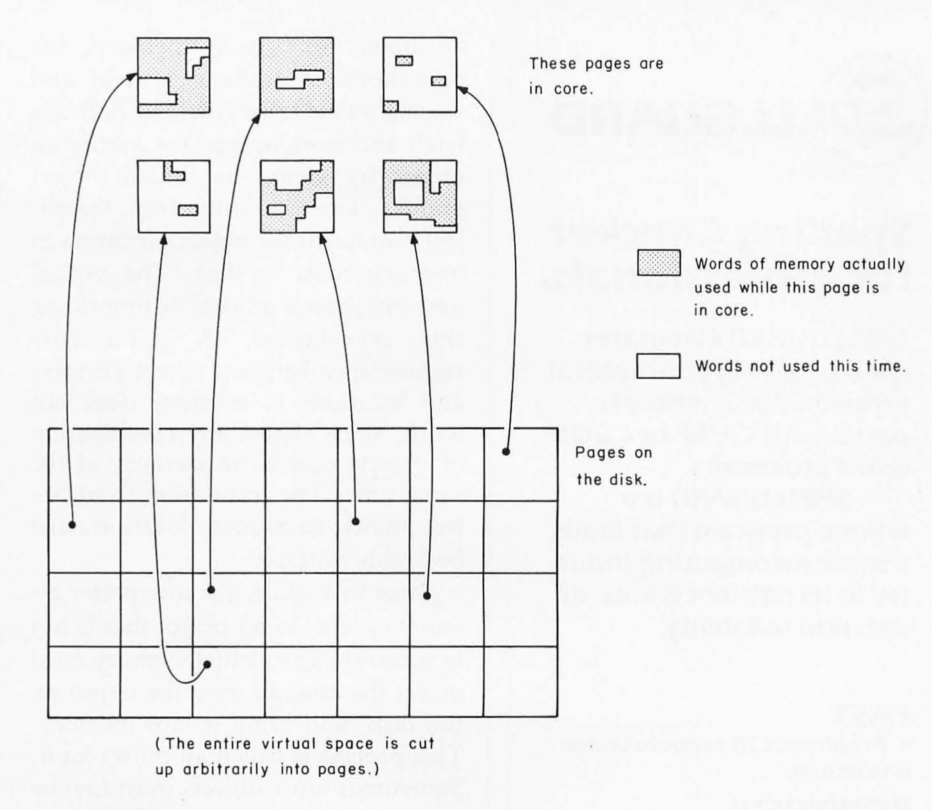


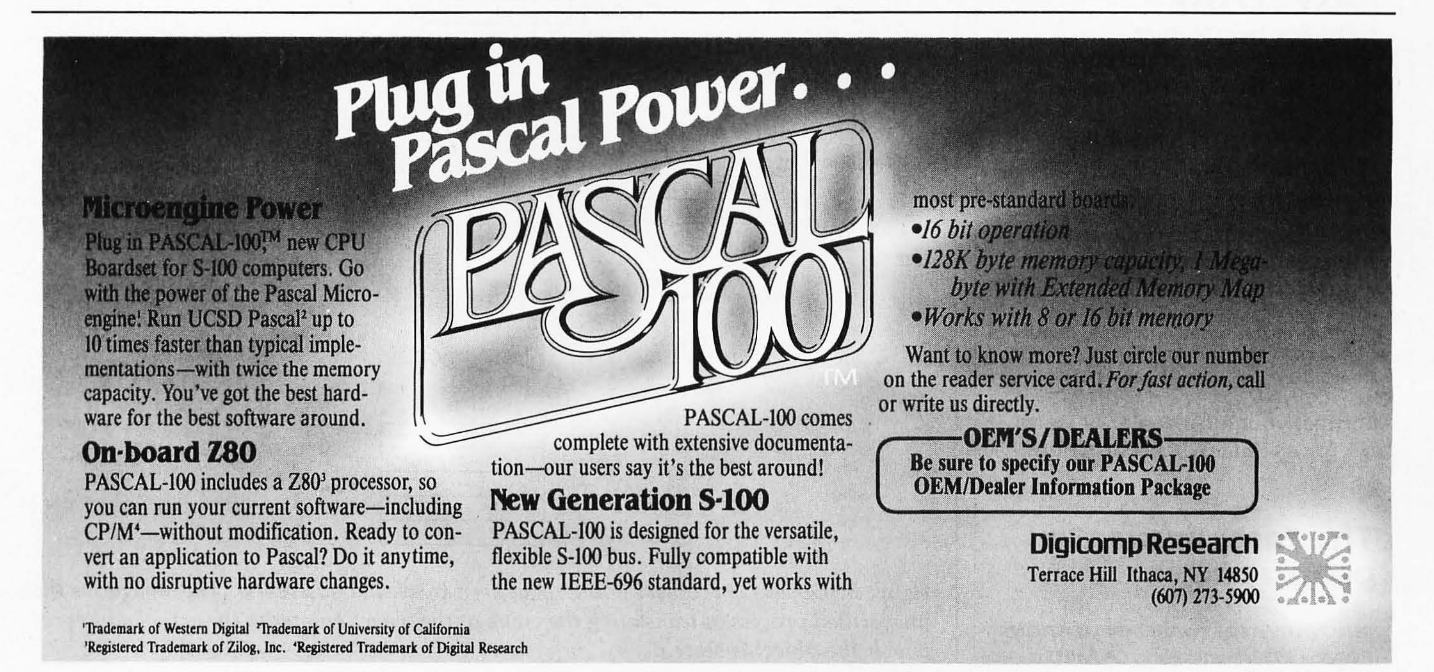
Figure 2: *Virtual memory by paging.*

Pointers to Objects

An object consists of *fields*, which hold the values of their named and indexed instance variables. Each field contains a numeric value, which can be interpreted as itself or (usually) as a pointer to another object. This number, called the *object pointer*, is the unique identifier of the other object. Every object has an object pointer. Given an object pointer, the virtual memory must be able to locate that object, whether it is in memory or on the disk (see figure 3).

Creating, destroying, and moving objects in memory is the job of a storage manager. The virtual memory program takes the place of the storage manager (as described in Glenn Krasner's article, "The Smalltalk-80 Virtual Machine," on page 300 of this issue). It fetches and stores the fields of objects, creates new objects, and collects and manages free space. It also keeps track of the length of each object and the Smalltalk class of each object.

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an object that is in memory, the operations of fetching a field and storing a field must run fast. Both the fetch and store operations specify an object by giving its unique object pointer. The translation from the object pointer to the object's location in memory must be fast. The virtual memory spends most of its time doing this translation. A fixed correspondence between object pointers and locations in memory does not work, since almost any combination of objects may be in memory at the same time. The translation from object pointer to memory location must be highly variable.

Once in a while, the interpreter attempts access to an object that is not in memory. The virtual memory must detect the attempt, find the object on the disk, and bring it into memory. This process is called an *object fault*. Sometimes other objects must first be removed from memory to make room for the incoming object. In order to find an object on the disk, there must be a correspondence between an object pointer and that object's location on the disk. The data needed to hold this correspondence must be compactly represented, as there may be many objects in the system.

OOZE

In 1975 and 1976, Dan Ingalls and I designed and built a virtual memory to support the Smalltalk-74 system, called OOZE (Object-Oriented Zoned Environment). It then became the foundation for the Smalltalk-76 system (reference 3). The combination was very successful, and many interesting projects have been built in it. OOZE serves as an excellent illustration of a usable object-oriented virtual memory implemented entirely in software. At the end of this article, we discuss possible modifications of OOZE for the Smalltalk-80 system.

For OOZE to play the game of virtual memory well, we had to design it to fit the rules. Economics (of our existing hardware) dictated the size of

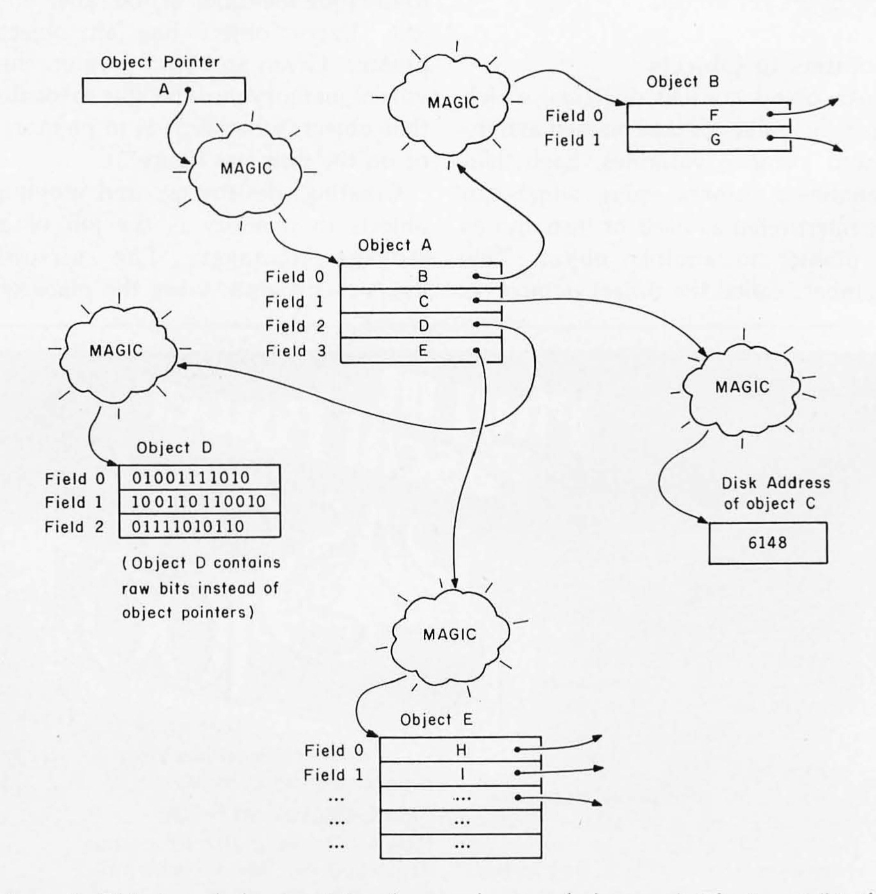


Figure 3: *Objects and object pointers (as seen by casual observers). The "magic" is the unspecified process of translating the value of the object pointer to the actual address at which the object is stored.*

main memory, the size of the disk, and the ratio of their speeds. The rules also included the things that the Smalltalk interpreter expected objects to do. We considered these and decided that in OOZE an object pointer would be 16 bits long, to fit into a machine word. We wanted every combination of 16 bits to be a legal object pointer, giving a total of 64 K objects. With a mean object size of 10 to 20 words, this was a good match to the size of our disk. To guarantee good performance during a fault on an object, we specified that any object can be brought into memory by reading, at most, one place on the disk. We did not allow one disk read to look up the disk address and another disk read to get the actual object.

The design of OOZE centers around the handling of the two important object pointer translations. Finding an object's location in memory from its object pointer must be fast. This mapping must also be flexible, since the exact combination of objects in memory changes from moment to moment. The correspondence between object pointer and memory location is a large hash table, called the *Resident Object Table* (ROT). Of the 64 K objects on the disk, perhaps 4000 are in memory at once. Each of these has an entry in the ROT. To find the location of an object, the hash routine uses the object pointer to compute where to look in the ROT. If it finds an entry whose object pointer matches, that entry also contains the memory address of the object (see figure 4). If the hash routine finds no match in the few entries it searches, the object is not in memory. The magic puffs of smoke in figure 3 depict the act of hashing an object pointer into the ROT to find its memory address.

OOZE must maintain the ROT. When an object is brought in from the disk, OOZE hashes its object pointer and looks in the ROT. When it finds an empty entry among the few possibilities, it claims that entry for the new object. Conversely, when an object is removed from memory and put back on the disk, its entry in the

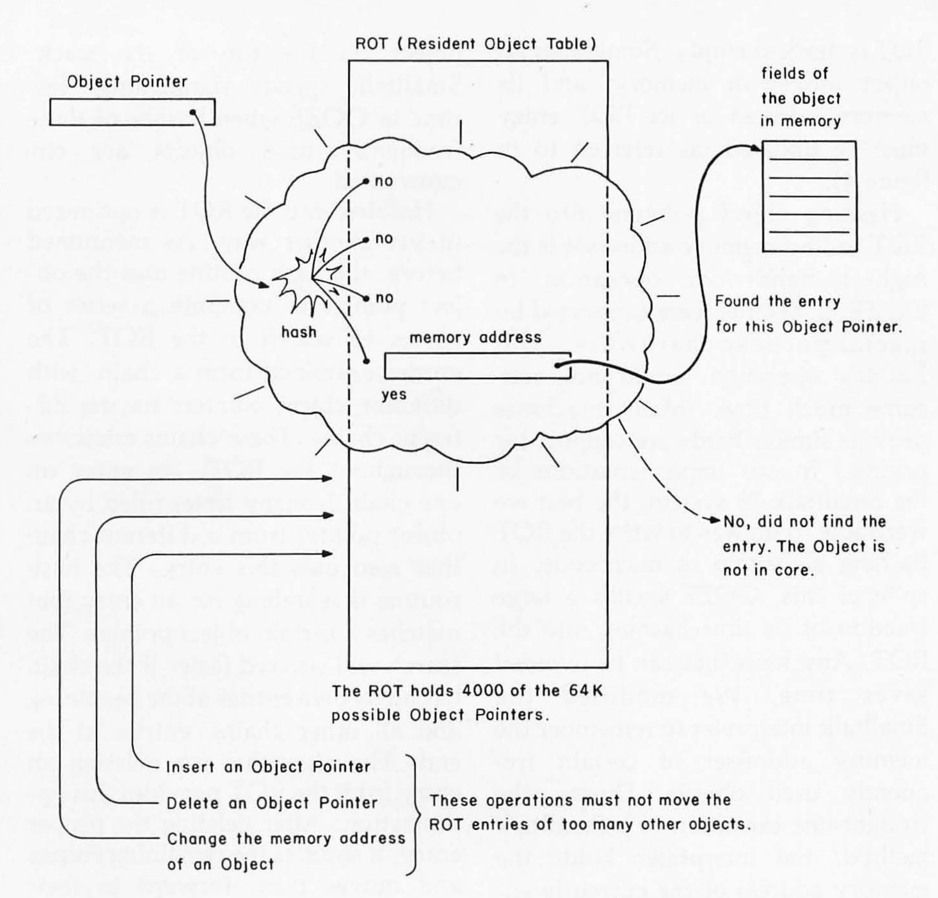


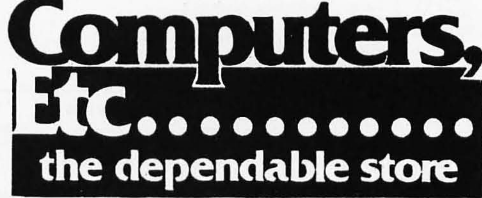
Figure 4: *Hashing an object pointer in the Resident Object Table (ROT).*

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ROT is marked empty. Sometimes an object moves in memory, and its memory address in its ROT entry must be updated (as referred to in figure 4).

Hashing object pointers into the ROT to find memory addresses is the highest bandwidth operation in OOZE. If hashing were supported by special-purpose hardware, the hashing operation would not consume much time. (Many machines provide similar hardware support for paging.) In our implementations of the Smalltalk-76 system, the best we were able to do was to write the ROT hashing algorithm in microcode. In spite of this, OOZE spends a large fraction of its time hashing into the ROT. Any hash that can be avoided saves time. We modified the Smalltalk interpreter to remember the memory addresses of certain frequently used objects. During the straight-line execution of a Smalltalk method, the interpreter holds the memory address of the currently executing method, the receiver, and the object on the top of the stack. Smalltalk spends significantly less time in OOZE when hashes of these frequently used objects are circumvented.

Hashing into the ROT is optimized in yet another way. As mentioned before, the hash routine uses the object pointer to compute a series of places to search in the ROT. The entries examined form a chain, with different object pointers having different chains. These chains crisscross throughout the ROT. An entry on one chain is many times filled by an object pointer from a different chain that also uses this entry. The hash routine is searching for an entry that matches a certain object pointer. The search will succeed faster if the chain has all its own entries at the beginning and all other chains' entries at the end. The algorithm for deleting an entry from the ROT provides this optimization. After deleting the proper entry, it shuffles the remaining entries and moves them forward in their chains. Because of this strategy, the average number of entries examined to find an object in memory is only 1.8. Typically, the resident object table is 80 percent full.

Finding an Object on the Disk

The translation from an object pointer to the disk address of the object is also important. Since a list of the disk addresses of all 64 K objects would easily fill up main memory, OOZE must use a trick. Instead of object pointers being assigned randomly to objects, information is encoded in each object pointer. This is done by dividing the set of object pointers into *pseudoclasses*. The bits in the upper part of the pointer indicate to which pseudoclass that object belongs. All objects in a pseudoclass have the same Smalltalk class and have the same length. The *Pseudoclass Map* is a table that is indexed with the pseudoclass number. There OOZE finds the length of the object and its class (see figure 5). A single Smalltalk class may own as many pseudoclasses as it needs to cover all of its instances. Classes whose instances may have indexable variables, such as class String, own a different pseudoclass for each length or range of lengths. The pseudoclass encoding saves space because each object does not use a word to hold its class or a word to hold its length. Objects in memory in OOZE are actually two words shorter than objects in the Smalltalk-80 system.

The disk address of an object is also found by using its pseudoclass. All objects in a pseudoclass are the same length, and they are stored consecutively on the disk. By knowing which object we want within the pseudoclass, we can compute its offset from the beginning of the pseudoclass. If we know the starting disk address of the pseudoclass, we can add the offset and find the object. The Pseudoclass Map contains the starting disk address of the object's pseudoclass (see figure 5). The low bits of the object's pointer tell which object it is within the pseudoclass. This encoding allows the disk addresses of all 64 K objects to be stored in 512 words of memory.

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(There are actually two additional levels of translation for the disk address. Tables for these take another 740 words).

By using the Pseudoclass Map, OOZE can find the disk address of any object from its object pointer. If it is in memory, OOZE also finds the object from its object pointer. *Thus the same object pointer serves to identify and find an object, no matter where the object is.* Because moving an object between disk and memory does not change its pointer, fields that point to the object need not change when the object moves. A field always contains the object pointer of the object to which it refers, regardless of the field's location and regardless of the object's location.

Storage Management

The management of the swapping space has several aspects. Objects are created and destroyed by Smalltalk upon request, and they are also moved in and out of memory. Each of these actions causes insertion or deletion in the ROT and allocation or deallocation in memory. Consider a class that wants to create a new instance: the new instance must receive an object pointer whose pseudoclass is already owned by that class. For this reason, we treat free instances of a class as legitimate objects. They "belong to the class" and can be swapped to and from the disk just like normal instances. Each class keeps a linked list of free instances. The class thinks that there are an infinite number of free instances on the disk, waiting to be swapped in. To create a new instance, the class merely pulls the first object off its "free list." If that object is not in memory, a fault brings it in from the disk. When a free list on the disk runs out, OOZE constructs new free instances on the disk as they are requested.

We have reduced the problem of managing memory and the ROT to the problem of swapping. Main memory has some free blocks between the areas being used for objects. These free blocks are linked together on free lists according to their size. The ROT also contains unused entries, which are marked as such. During an object fault, OOZE

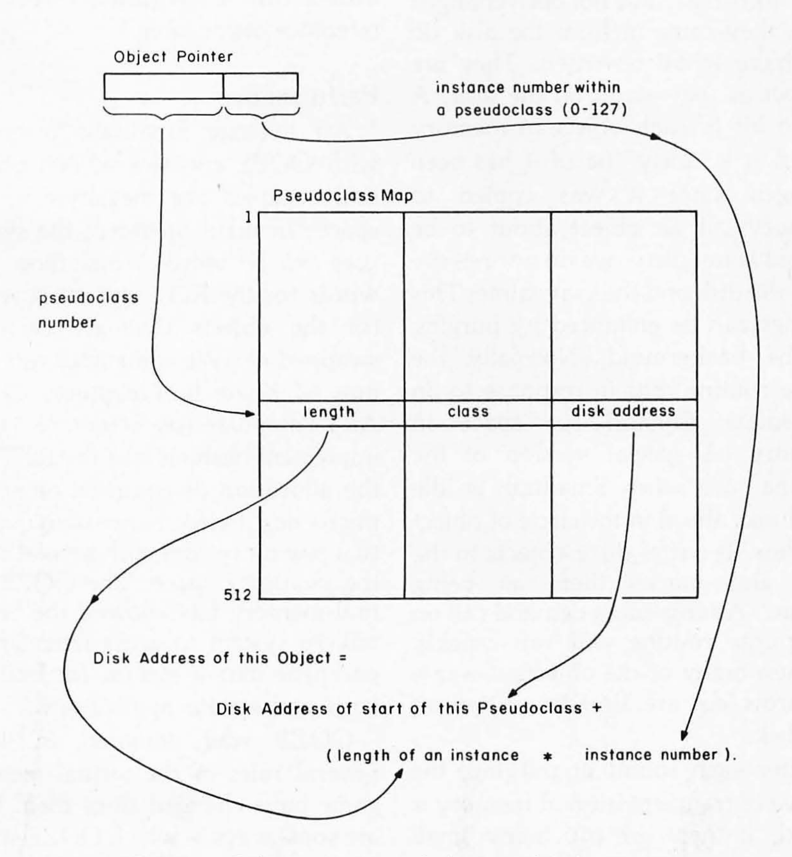


Figure 5: *Information encoded in an object pointer.*

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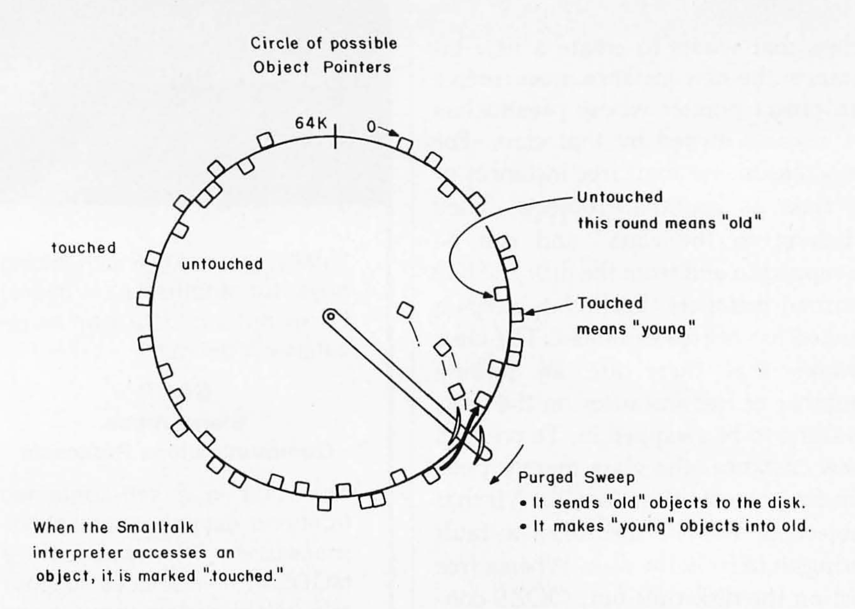


Figure 6: *The order in which objects are purged from main memory.*

claims a free ROT entry and a proper-sized block of memory for the incoming object. Occasionally, OOZE cannot find a legal ROT entry or a free block of memory that is large enough. The fault routine stops, and OOZE starts purging objects from memory by copying them to their proper places on the disk. It then frees the memory space and ROT entries of the objects it throws out. When the purge routine finishes, the fault routine resumes its work.

The purge routine must decide which objects to throw out of memory. To play the game of virtual memory perfectly, OOZE should keep the objects which will be used soon and throw out those which will not. Since OOZE cannot see into the future, it throws out the least recently used objects. Objects that have been active recently are kept, and inactive ones are tossed out. The purge routine examines objects in memory in an order determined by their object pointers. Consider the space of all object pointers to be a circle. The purge routine tours the circle, keeping objects that have been accessed since the last time around. Objects that have remained unaccessed since the routine last visited them are purged to the disk (see figure 6). Typically, it takes several calls on the purge routine to complete a tour of the circle of object pointers.

Purging objects in order of their object pointers has a very important side effect. Since all objects in a pseudoclass are consecutive on the disk, purge sends out the objects it is purging in the same order that they appear on the disk. This minimizes the movement of the disk head and saves time.

Objects that have not been changed since they came in from the disk do not have to be rewritten. They are correct as they stand on the disk. A single bit in each object in memory tells if it is "dirty" (ie: if it has been changed since it was copied to memory). If an object about to be purged is not dirty, we do not rewrite it on the disk and thus save time. This savings can be enhanced by purging in the background. Normally the purge routine runs in response to an immediate demand for space in memory. A special version of the routine runs when Smalltalk is idle and looks ahead in the circle of object pointers. It writes dirty objects to the disk and marks them as being "clean." A subsequent demand call on the purge routine will run quickly because many of the objects it wants to throw out are already written on the disk.

After each round of purging, the degree of fragmentation of memory is tested. If there are too many small blocks and no big ones, we perform a *compaction*. All objects are moved to one end of memory and all free blocks are merged into a single block at the other end. Memory addresses are updated in the ROT entries of the objects that have moved. OOZE performs this operation without using additional storage in order to keep a list of which objects have moved to which place in memory.

As a storage manager, OOZE must detect when an object is no longer being used. Like the storage manager mentioned in Krasner's article, OOZE uses *reference counting*. When the reference count of an object goes to zero, its object pointer is not in any field of any other object. At this point, it is impossible for that object ever to be accessed by the interpreter. OOZE, therefore, puts the object on its class's free list. Before doing so, however, it decreases the reference count of the object pointed to by each field of this object. In the process, more counts may go to zero, and more objects may get freed. To save space, reference counts are only four bits wide. The few objects with fifteen or more fields pointing at them are noted in a separate overflow reference count table.

Performance

An average Smalltalk-76 system with OOZE contains 40,000 objects and occupies one megabyte of disk space. In main memory, the system uses 96 K words, including 8 K words for the ROT and 40 K words for the objects that are currently swapped in. (We sometimes run with only 64 K words of memory.) On the Alto computer (see reference 1), we implement hashing into the ROT and the allocation of common objects in microcode. Performance is equivalent to a paging system with several times the swapping space. The OOZE virtual memory has allowed the Smalltalk-76 system to grow from an experiment into a system for building large and serious applications.

OOZE was designed in 1975. Several rules of the virtual memory game have changed since then. Here are some ways in which OOZE shows its age at Xerox PARC:

•Users can afford more disk and more memory. They want to build systems that contain more than 64 K objects. OOZE cannot be easily expanded beyond this limit.

•Several extensions to the Smalltalk language encourage the user to create lots of classes. OOZE has a limit of 245 classes, and many serious users have encountered this limit.

Naturally, our minds have turned to building a virtual memory for the Smalltalk-80 system with even better performance than OOZE. In 1980, a group of us at Xerox PARC designed just such a system, the *Large Object-Oriented Memory* (LOOM). Individual objects in LOOM carry slightly more overhead than objects in OOZE. (Since users can afford more memory, this is not a problem.) Besides allowing a much larger virtual space and unlimited classes, LOOM provides some new properties:

•LOOM accesses objects that are in memory simply by indexing a table, as does the resident Smalltalk-80 system. LOOM thus saves the time that OOZE spends hashing into the ROT whenever it wants a memory address. During the table lookup which finds an object's memory address, LOOM tests for the case when the object is not actually in memory. To run faster than a hash in OOZE, the test must be very simple and fast.

•LOOM is designed with the idea in mind of grouping objects on the disk. If objects that are faulted on together can be arranged into groups on the disk, the system will run faster. LOOM will be a test bed for schemes that optimize the organization of objects on the disk.

Conclusion

The goal of the virtual memory game is to make a mixture of fast and slow memory perform almost as well as if it were all fast memory. The strategy is to guess what information the processor will need soon and move it to fast memory. In an object-oriented language such as Smalltalk, the object is an excellent unit for locality of reference. Once an object is accessed, it will most likely be accessed again soon. Recently used objects have a similar degree of locality to recently used pages, and many more objects than pages fit into a given amount of fast memory.

OOZE is the first representative of the new category of object-oriented virtual memories. These systems use a construct in the high-level language, the object, as the unit of swapping. Objects as small as one field in length are swapped individually by the same mechanism used for large strings and arrays. To be a member of this category, a virtual memory must also have automatic control of swapping and automatic creation and freeing of objects. While OOZE is implemented in software, we believe that future systems will be implemented like languages: hardware assist for a few high-bandwidth operations, some microcode, and support code in machine- or high-level language. We expect that mature object-oriented virtual memories will identify groups of objects that are used together and swap them as a unit.

As the virtual memory which supports the Smalltalk-76 system, OOZE is interesting in itself. It provides the ability to address 2^N *objects* with N-bit pointers. Only currently active objects occupy memory, and they are packed end to end. This provides exceedingly good use of memory. Because the class and length of an object are encoded in the object pointer, that information does not occupy space with each object in memory. Movement of the disk head is reduced because objects are purged to the disk in the order of their disk addresses. OOZE is implemented in software without any special hardware support. It runs in an amazingly sprightly fashion and performs as well as paging systems with several times the swapping space.

The fact that Smalltalk uses objects consistently and completely allows its virtual memory to be radical in design. Object-oriented virtual memories get their power from a close coupling with the high-level languages they serve. The success of OOZE and the changing rules of the virtual memory game have inspired the design of LOOM, a larger and more efficient object-oriented virtual memory.■

References

1. Bell, C G and Alan Newell. *Computer Structures: Readings and Examples*, New York: McGraw-Hill, 2nd edition, 1980.
2. Denning, P J. "Virtual Memory," *Computing Surveys*, Volume 2, Number 3, September 1970, page 153.
3. Ingalls, Daniel H H. "The Smalltalk-76 Programming System: Design and Implementation," *Conference Record, Fifth Annual ACM Symposium on Principles of Programming Languages*, 1978.
4. Shaw, Alan C. *The Logical Design of Operating Systems*, Englewood Cliffs NJ: Prentice-Hall, 1974.
5. Wulf, W A, et al. *HYDRA/C.mmp*, New York: McGraw-Hill, 1981, Chapter 11.

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Language Requirements

Dear Steve,

How much ROM (read-only memory) and programmable memory is necessary to program in languages like BASIC, FORTRAN, Pascal, and COBOL? I have read your articles in BYTE, but I haven't seen anything about this subject.

Stephen Walaski
Russellville AR

The actual amount of memory in a system is often more dependent upon economics than on need. There are systems sold with anywhere from 2 K- to 12 K-byte BASIC interpreters. Generally speaking, a "tiny" BASIC would require 2 K to 4 K bytes of ROM (read-only memory) and from 1 K to 4 K bytes of programmable memory for operator entries. A full BASIC, or extended BASIC as it's often called, usually occupies between 8 K and 12 K bytes of ROM space. Systems that have a ROM BASIC usually have 4 K to 16 K bytes of programmable memory. This is what's typically found on the Radio Shack TRS-80 and Apple II computers. In both of these systems, the programmable memory can be expanded to 48 K bytes.

For high-level languages such as FORTRAN, Pascal, or COBOL, which are compilers rather than interpreters, a disk is a necessary part of the computer system. The disk operating system can often occupy 4 K to 8 K bytes and is generally stored in the programmable memory when in use. When you load the compiler software, it can use an additional 12 K to 20 K bytes. So, for FORTRAN, Pascal, or COBOL, you may have 20 K to 28 K bytes of programmable memory occupied before you've written a single line of code.

Generally speaking, anyone wishing to use such high-level languages would be well advised to have, at a minimum, 48 K bytes of programmable memory. When operating with a disk, the ROM often becomes immaterial other than as a "bootstrap" loader, so I don't see that any particular amount is necessary. . . . **Steve**

A Tank List Job

Dear Steve,

I would like to know two things about your article "A Computer-Controlled Tank." (See the February 1981 BYTE, page 44.)

- What computer was the control program written for?
- Can the circuitry be modified for an Ohio Scientific C1P to control a small Radio Shack tank?

Ken Pataska
Kenosha WI

The control program for my computerized tank was written in standard extended BASIC. I used a Digital Group Z80-based computer to write the original program, but the same program has been run on both a Radio Shack Model I and Model III.

As far as using a similar circuit for the Radio Shack tank, I would guess that the circuit could provide on/off control, but the operation of Radio Shack's tank is very different from Milton Bradley's Big Trak. If you can live with sending out single commands and no local program storage in the tank, there should be no reason why the Radio Shack tank could not be controlled by any computer. . . . **Steve**

Modem Inquiries

Dear Steve,

I have a few questions about your August 1980 BYTE article "A Build It Yourself Modem for Under $50."

- How does one calibrate the frequencies accurately?
- Is this modem a two-line, full-duplex coupler?
- Are the kits you mentioned at the end of the article still available?
- Where can I purchase cables and connectors?

I own a Heathkit H-89 (alias Zenith Z89) with a three-port RS-232C board installed.

Brian J Mork
Holland MI

The modem presented in that article has been very popular, and many hundreds have been purchased by experimenters. It is still available from The Micromint (917 Midway, Woodmere NY 11598). It costs $39.95, plus $2 for shipping.

Regarding the electronics of the modem, it could be considered a two-line, full-duplex modem except that there are really three wires between the computer. One carries data from the modem to the computer, one carries data from the computer to the modem, and the third is the ground. You should have no problems attaching the modem to a Heath H-89; and, to my knowledge, the connectors and cables are available from Radio Shack.

As far as calibrating the frequencies: the manual provided with the Modem Kit describes calibration using standard test instruments. It also describes a fairly quick and easy way to accomplish this. The method uses an answer modem to serve as a frequency source. The Micromint also has recorded answer-modem frequencies on cassette tape available. . . . **Steve**

Multi-Dimensional Problem

Dear Steve,

We bought an Olivetti electronic typewriter that features a daisy-wheel printhead, proportional spacing, memory, etc. We were told it would "interface" with a computer. At that time we didn't even know what interface meant, but found out later. We then looked at word processors, such as Vydec and Dictaphone, that are able to show a whole page of 69 lines with 160 columns. In our ignorance, we thought that was standard, even though we saw some machines with only 80 columns by 24 lines. Not being able to afford the $8500 to $15,000 cost of a word processor, we thought that we had a line printer in the Olivetti. We decided to get a cheap computer, hook them together, and then we would have what we needed, and cheap.

That's when we ran up against the 24-line, 80-column problem. Now giving us 24 lines and 80 columns when we have hundreds of pages to lay out, with printing to go around pictures, etc, is like trying to do layouts on a sheet of 8½- by 11-inch

paper with about two-thirds of it covered at all times. Sure, you can scroll up and down and sideways, but how can you judge a layout if you can't see the whole page? When you are writing, how can you remember what you said in the first paragraph when you are at the bottom of the page?

Everywhere we went, we asked why microcomputers were limited to 80 columns and 24 lines, and we got a different answer from each store. One said it was the video display that limited it, one said it was some circuit in the computer, one said it was the cheap way that computers are built, but mostly they looked at us blankly and said they didn't know. We wrote to manufacturers, to companies all over, and no one has even answered our letters, so now it's your turn: What limits the format size of the video display, and can we get a full 160-character by 69-line page on a video display using one of the less expensive computers such as the Radio Shack TRS-80?

Sam Millar
Olympia WA

Let me assure you that video displays with 69 lines by 160 characters are very unusual. Most personal computers have 16 or 24 lines of 64 characters, and most commercial units have 24 lines of 80 characters. The difference between them is not that one is a cheap computer and the other is not, but that the electronics of a 69 by 160 format is considerably more expensive than a 24 by 80 format.

When you buy a word-processing system, be aware that there are many more features than the number of lines that are displayed on the screen. The software is far more important. Frequently, word-processing systems have 16 by 64 characters on a screen, but good word-processing software will allow you to print the final copy at any line length. In fact, the system that I use has a 16-line by 64-character display, but it allows me to print out up to 132 characters per line.

One possible approach for you is to attach your Olivetti to an inexpensive personal computer and get some high-powered software. If you don't mind the time limitations involved with occasionally dumping the full document to the printer to see how it looks, it should not be too cumbersome.

Keep in mind that you get what you pay for. If you buy a $20,000 word-processing system, one of the features you can get is full-page display. However, you should be able to configure a microcomputer-based word-processing system that produces almost identical final copy for under $4000.

I hope I've helped you in some way. I do all of my writing on a word processor and I find it invaluable.
. . . Steve

Coming Across Assemblers

Dear Steve,

I can't seem to be able to find a cross-assembler for the Texas Instruments TMS-1000 microcomputer, written in FORTRAN or in BASIC, that could run on a home computer such as the Apple II. Does something like this exist? If not, do you know of a development system?

Guy Chemla
Le Kremlin Bicetre, France

Texas Instruments has cross-assemblers that run on Digital Equipment Corporation's PDP-11/70 and VAX systems and on the IBM 370. These are hardly inexpensive cross-assemblers. Texas Instruments does, however, sell a 9900-based computer that emulates and supports the TMS-1000. The hardware includes a video display, two floppy-disk drives, the chassis with 9900 processor, 64 K bytes of memory, and the software. It's called the TAM 9000 system. It costs approximately $20,000.
. . . Steve

Article Information

Dear Steve,

I would like to interface my IBM Selectric typewriter to my 16 K-byte TRS-80 Level II. I do not have the Expansion Interface, but I would like to have Selectric-quality hard copy.

Where can I get information on buying or building the necessary interfacing circuitry and other items essential for the conversion?

J W Rankin, Jr
Memphis TN

There are many different ways of attaching an IBM Selectric to a computer. You don't necessarily need the Expansion Interface to do it with a TRS-80.

Many articles have been published in the past few years concerning the Selectric. You may do better to look up a few and choose among the different ways presented.

The following is a partial list:

Interface Age, *January 1978, page 148.*
Kilobaud, *May 1978, page 64*
Kilobaud, *June 1978, page 22*
Kilobaud, *July 1978, page 40*
Kilobaud, *November 1979, page 134*
Kilobaud, *December 1979, page 144*
BYTE, *June 1977, page 46*
BYTE, *October 1977, page 174*
BYTE, *October 1977, page 36*
Kilobaud, *July 1977, page 5*

These magazine article listings came from the Periodical Guide for Computerists *by E Berg Publications, 622 E Third, Kimball NE 69145.*
. . . Steve

One Eye Toward the Past

Dear Steve,

I read your columns in BYTE and enjoy them very much. A few years back there was an article about a solid-state television-camera project called Cyclops. The heart of the system was a 32 by 32 photosensitive array. Have you heard of this device or the article?

Dennis Sprague
Great Falls MT

The article that you are interested in is indeed called "Cyclops." It was in the February, 1965, Popular Electronics. *The 32 by 32 photosensitive array is in fact a dynamic memory chip.*
. . . Steve

Off to a Slow Start

Dear Steve,

In college, the only computer I had a chance to use was a PDP-8. Since that time, I haven't had an opportunity to use a computer, with the exception of my Texas Instruments SR-56 and a TRS-80 down at the Radio Shack. I try to keep up-to-date on the microcomputer field as much as possible. I have basic knowledge of electronics and microcomputers, but the language used in BYTE is sometimes too technical for me. Could you recommend some books, articles, etc?

I have concentrated my study on Intel's 8080 microprocessor, and am interested in building a system around it, using the S-100 bus. I envision using a video display for

writing programs and a cassette for storage.

My budget is limited, so I was wondering if this system is my best approach? I plan to buy bare boards and do most of the construction myself. How do I know which boards will be best for my system? Where can I get more information on system components, such as floppy disks, video-display and processor boards, etc?

Any advice would be greatly appreciated.

Douglas B Powers
North Platte NE

Many people write and ask me where to start. Generally, I have the same answer: It really depends upon what you mean by "starting." Are you just concerned with learning about microcomputers or are you trying to build a system, one board at a time, that will compete with an IBM 370? You either have to have an idea of what you want as an end result when you start, or be satisfied with learning the basics and possibly replacing that system. Your second system would attempt to be closer to the final system that you want.

As far as books, the best suggestion, obviously, is to go to a bookstore that has many technical books and look through them. Or join the McGraw-Hill Electronic Engineers Book Club—I've belonged to it for years.

I have just written a book on building your own Zilog Z80-based computer from scratch that I would like to recommend, but it is intended to teach you about the Z80. I doubt that it could ever compete with a quad-disk Cromemco System simply by the fact that much more support is needed to add disk drives, etc.

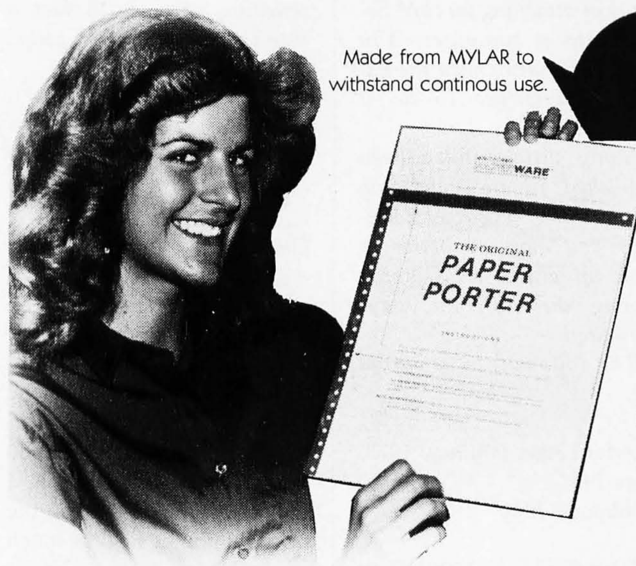
If you are intent upon starting with a system that is not of your own design, then I recommend buying blank S-100 boards and "populating" them. It is a very inexpensive path to follow and can result in a valuable system later on. Unfortunately, populating boards does not necessarily teach you much about designing a custom computer system nor does it allow you to deviate from the functions available on those cards.

One final note, this month's and last month's "Circuit Cellar" articles are about a 4- by 4½-inch tiny BASIC computer, which is offered as an inexpensive kit. All you have to do is add a video terminal (you envisioned starting with video display anyway) and immediately you would be able to start off with a tiny BASIC preprogrammed in ROM. It also has 4 K bytes of programmable memory on board. You might want to consider it as an inexpensive way of starting. . . . **Steve**■

In "Ask BYTE," Steve Ciarcia answers questions on any area of microcomputing. The most representative questions received each month will be answered and published. Do you have a nagging problem? Send your inquiry to:

Ask BYTE
c/o Steve Ciarcia
POB 582
Glastonbury CT 06033

If you are a subscriber to The Source, send your questions by electronic mail or chat with Steve (TCE317) directly. Due to the high volume of inquiries, personal replies cannot be given. Be sure to include "Ask BYTE" in the address.



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- **MF-005 Printer Overlay** Same as #4 but clear mylar, avialable singly.
- **MF-007 Cobol Programming Pads** uses standard Cobol layout & col.

All Items except MF-005 & MF-006 are printed in fadeout blue on offset stock and are padded in 50's. Available **5 pad minimum, $2.75 each.** Prices include shipping within Cont. U.S.A.

DEALER INQUIRES INVITED

Circle 412 on inquiry card.

Books Received

This is a list of books received at BYTE Publications during this past month. Although the list is not meant to be exhaustive, its purpose is to acquaint BYTE readers with recently published titles in computer science and related fields. We regret that we cannot review or comment on all the books we receive; instead, this list is meant to be a monthly acknowledgment of these books and the publishers who sent them.

Basic Business Software, E G Brooner. Indianapolis IN: Howard Sams & Company, 1980; 13.5 by 22 cm, 141 pages, softcover, ISBN 0-672-21751-1, $9.95.

Basic Electrical Engineering, Fifth Edition, A E Fitzgerald, D Higginbotham, and A Grabel. New York: McGraw-Hill, 1981; 17.5 by 24.5 cm, 937 pages, hardcover, ISBN 0-07-021154-X, $28.95.

Computer Language Reference Guide, Harry L Helms Jr. Indianapolis IN: Howard Sams & Company, 1980; 13.5 by 22 cm, 109 pages, softcover, ISBN 0-672-21786-4, $6.95.

Computer Networks and Distributed Processing: Software, Techniques, and Architecture, James Martin. Englewood Cliffs NJ: Prentice-Hall, 1981; 19 by 24.5 cm, 562 pages, hardcover, ISBN 0-13-165258-3, $34.

Computer Networks in the Chemical Laboratory, G Levy and D Terpstra, editors. New York: John Wiley & Sons, 1981; 16 by 23.5 cm, 221 pages, hardcover, ISBN 0-471-08471-9, $27.50.

Computer Programs in BASIC, Paul Friedman. Englewood Cliffs NJ: Prentice-Hall, 1981; 23 by 29.5 cm, 271 pages, hardcover, ISBN 0-13-165225-7, $19.95. Available in softcover for $10.95.

Database Security and Integrity, E Fernandez, R Summers, and C Wood. Reading MA: Addison-Wesley, 1981; 16.5 by 24.5 cm, 320 pages, hardcover, ISBN 0-201- 14467-0, $17.95.

Data Dictionaries and Data Administration—Concepts and Practices for Data Resources Management, Ronald G Ross. New York: AMACOM, 1981; 16.5 by 23.5 cm, 454 pages, hardcover, ISBN 0-8144-5596-4, $29.95.

History of Programming Languages, R Wexelblat, editor. New York: Academic Press, 1981; 18.5 by 26 cm, 758 pages, hardcover, ISBN 0-12-745040-8, $45.

Introduction to 8080/8085 Assembly-Language Programming: A Self-Teaching Guide, J Fernandez and R Ashley. New York: John Wiley & Sons, 1981; 17.5 by 25.5 cm, 303 pages, softcover, ISBN 0-471-08009-8, $8.95.

Introduction to Pascal for Scientists, James W Cooper. New York: John Wiley & Sons, 1981; 16 by 23.5 cm, 260 pages, hardcover, ISBN 0-471-08785-8, $19.95.

Lecture Notes in Computer Science, Directions in Human Factors for Interactive Science, H Ledgard, A Singer, and J Whiteside, edited by G Goos and J Hartmanis. New York: Springer-Verlag, 1981; 16.5 by 24.5 cm, 190 pages, softcover, ISBN 3-540-10574-3, $11.80.

Managing a Programming Project, Second Edition, Philip W Metzger. Englewood Cliffs NJ: Prentice-Hall, 1981; 16 by 23.5 cm, 244 pages, hardcover, ISBN 0-13-550772-3, $22.95.

Microcomputer Architecture and Programming, John F Wakerly. New York: John Wiley & Sons, 1981; 17.5 by 23.5 cm, 692 pages, hardcover, ISBN 0-471-05232-9, $27.95.

More TRS-80 BASIC, A Self-Teaching Guide, D Inman, R Zamorá, and B Albrecht. New York: John Wiley & Sons, 1981; 18.5 by 23.5 cm, 280 pages, softcover, ISBN 0-471-08010-1, $9.95.

Nailing Jelly to a Tree, J Willis and W Danley Jr. Beaverton OR: Dilithium Press, 1981; 14 by 22 cm, 244 pages, softcover, ISBN 0-918398-42-8, $12.95.

Structured COBOL, Fundamentals and Style, Tyler Welburn. Palo Alto CA: Mayfield Publishing, 1981; 22 by 27.5 cm, 535 pages, softcover, ISBN 0-87484-543-2, $18.95.

Systems Programmer's Problem Solver, William S Mosteller. Englewood Cliffs NJ: Prentice-Hall, 1981; 16 by 23.5 cm, 223 pages, hardcover, ISBN 0-87626-830-0, $18.95.

Telecommunications—Management for Business and Government, Larry A Arrendondo. New York: Telecom Library, 1981; 22 by 28 cm, 270 pages, softcover, ISBN 0-936648-07-4, $30.

User's Guidebook to Digital CMOS Integrated Circuits, Eugene R Hnatek. New York: McGraw-Hill, 1981; 16 by 23.5 cm, 339 pages, hardcover, ISBN 0-07-029067-9, $24.50.■

Software Received

Automatic Graphing of Functions, multifaceted function plotter for the TRS-80 Model I Level II and Model III. Cassette, $19.95. David L Modney, 4144 N Via Villas, Tucson AZ 85719.

B.I.T.S. BASIC Interactive Terminal Software, Version 3.0, intelligent terminal software for the Apple II. Floppy disk, $44.95. Software Sorcery Inc, 7927 Jones Branch Dr, McLean VA 22102.

Hyper-B.I.T.S., 1200 baud version of B.I.T.S. for the Apple II. Floppy disk, $64.95. Software Sorcery Inc (see above).

Mailing List Package Version 3.1, name and address data base for the Apple II. Floppy disk, $49.95, Software Sorcery Inc (see above).

Pool 1.5, pool table simulation for the Apple II. Floppy disk, $34.95. IDSI, 3210 Mercury, Las Cruces NM 88004.

Raster Blaster, electronic pinball simulation for the Apple II. Floppy disk, $19.95. BudgeCo, 428 Pala Ave, Piedmont CA 94611.

Super Invasion, Space-Invader-type game for the Sinclair ZX80. Cassette, $14.95. Softsync Inc, POB 480, Murray Hill Sta, New York NY 10156.■

This is a list of software packages that have been received by BYTE Publications during the past month. The list is correct to the best of our knowledge, but it is not meant to be a full description of the product or the forms in which the product is available. In particular, some packages may be sold for several machines or in both cassette and floppy-disk format; the product listed here is the version received by BYTE Publications.

This is an all-inclusive list that makes no comment on the quality or usefulness of the software listed. We regret that we cannot review every software package we receive. Instead, this list is meant to be a monthly acknowledgment of these packages and the companies that sent them. All software received is considered to be on loan to BYTE and is returned to the manufacturer after a set period of time. Companies sending software packages should be sure to include the list price of the packages and (where appropriate) the alternate forms in which they are available.

Clubs and Newsletters

UNIX Users Club

Uni-ops is a new group for UNIX supporters. Uni-ops publishes a monthly journal and a directory. Contact Uni-ops at POB 5182, Walnut Creek CA 94596, (415) 933-8564.

TI-99/4 Users Groups In Your Area

San Diego 99/4 Users Group, 4037 Johnson Dr, Oceanside CA 92054, (714) 758-4292. Contact Paul Yates.

Denver 99/4 Users Group, CRS Inc, 4860 Ironton, Suite E, Denver CO 80239, (303) 371-8272. Contact Rick Savage.

99/4 Home Computer Users-Group Inc, POB 95148, Oklahoma City OK 73143, (405) 787-8521. Contact Charles LaFara.

Pacific Northwest TI-99/4 Users Group, POB 5537, Eugene OR 97405, (503) 485-8796. Contact Gary Kaplan.

Pittsburgh 99/4 Users Group, 111 Teeple Ave, Donora PA 15033, (412) 379-5976. Contact R Riley.

Houston Users Group, 8922 Roos Rd, Houston TX 77036, (713) 771-3483. Contact Raymond Wells.

Washington DC 99/4 Users Group, POB 267, Leesburg VA 22075, (703) 777-2017. Contact Bill Whitmore.

Atlanta TRS-80 Users

The TRS-80 Users Group of Atlanta, Georgia, meets on the second Tuesday of each month at 7:30 PM at radio station WABE on 740 Bismarck Rd NE in Atlanta. Contact Bob Green, 1315 Rustic Ridge Dr NE, Atlanta GA 30319, (404) 451-9813.

Users Group of Floridia

The Tallahassee Amateur Computer Society meets on the second Thursday of the month. Members' computers range from HP-41Cs to Apples, Ataris, TRS-80s, and S-100 systems. Club interests are in the uses of microcomputers in education, business, and personal applications. A monthly newsletter, *Text File*, is published. Contact the group at POB 6716, Tallahassee FL 32301.

CAPE

CAPE (Capital Area PET Enthusiasts) meets monthly and discusses problems, swaps ideas and programs, and works on hardware projects. For information, contact CAPE, c/o Bob Karpen, 2054 Eakins Ct, Reston VA 22091, (703) 860-9116.

Robot Builders and Users

David Smith is starting a club in the northern New Jersey/New York Metropolitan area for those interested in building or working with robots. Even if you are too far away to attend meetings, he wishes to hear from you. David offers help to anyone with questions or problems concerning robots. Contact him at 4505 Kennedy Blvd, North Bergen NJ 07047, (201) 856-4890.

Atari Users Group

The Cincinnati area has a new group for Atari 400 and 800 users. Anyone who uses or owns Atari microcomputers is welcome. Contact Ron Shaefer, (513) 671-1671; or Tom Candelaresi, c/o Computer-Tutor, 4012 Benjamin Dr, Cincinnati OH 45245, (513) 752-7522.

DENSPET

DENSPET is an international association for the exchange of programs for the MTU 200 by 320 dot high-resolution PET accessory. Send a sample of your work or $5 and receive a sample in return plus a subscription to a newsletter and lists of available programs. Contact DENSPET, Rock House, Ballyoroy, Westport, County Mayo, Ireland.

Vancouver Users

The Vancouver TRS-80 Users Group wishes to exchange newsletters and information on homebrew software and hardware with other TRS-80 clubs. Contact them at POB 46608, Station G, Vancouver, British Columbia, V6R 4G8, Canada. Their newsletter is entitled *USR(80)*.■

BYTE's Bugs

Incorrect BASIC Sorcery

We regret that some errors popped up in "Whose BASIC Does What?" by Teri Li (January 1981 BYTE, page 318) in the entries for the Exidy Sorcerer computer.

Checkmarks should have appeared in the Exidy column for these BASIC statements: CLEAR *n*, DEF FNY (*name*), DIM *var*(*k*), and OUT *port-num*, *val*. The column for the HOME command should have contained the equivalent PRINT CHR$(17), and the column for the CLS keyword should have included PRINT CHR$(12).

The Sorcerer's BASIC interpreter also contains some features not found in other versions of BASIC, but due to the nature of the article, we were not able to include many of these. In any event, when choosing a computer or translating a program, you may still need to consult the reference manuals for the computers involved.

Thanks to Robert W Harrison of Cortland, New York, and others for pointing out the errors.

Forgotten Line

One line of BASIC code was inadvertently omitted from listing 1 of "Generating Bar Code in the Hewlett-Packard Format," by Thomas McNeal. (See the January 1981 BYTE, page 148.) The line, which should be placed at the beginning of page 162, is shown in listing 1.

We regret the error.

Listing 1

```
1855 M1 = 1   !START MACHINE-
         CODE ARRAY INDEX AT 1
```

March Editorial Error

An error occurs in listing 1 (page 212) of Gregg Williams' March 1981 editorial, "Is This Really Necessary?" The second *else* in the listing, the one that precedes the statement "check-amount=0" should *follow* that statement. In other words, the check amount should be set to 0 only when no table match has been found. Our thanks go to Mr M F Fay of Cincinnati, Ohio, for pointing this out.■


A SHOPPERS DREAM
BY
TOM SLOAN
HONEY, WOULD YOU GO SHOPPING FOR DINNER TONIGHT.
SURE THING SWEETIE PIE.
CAN I BORROW YOUR TINY COMPUTER?
HERE IT IS HONEY BUNCH
FOODLA
10¢ LBS
TEN
HMM?...
GIANT ECONOMY SIZE
EXTRA STRENGTH
TIN
NEW AND IMPROVED
1001 USES
TIN
10¢ OFF
LETS SEE... ONE BOX IS 13 OZ. AND COSTS 1.99, THE OTHER IS 29 OZ. AND IS A BUCK 2.80. AND WE HAVE 6 OZ. AT HOME STILL AND WE ONLY USE 2 OZ. A YEAR AND I HAVE ONLY $10.00 TO SPEND, AND INFLATION IS 12% AND..UH...
...NUTS! THIS IS GETTING TOUGH.
I BETTER CALL MY WIFE AND ASK HER ABOUT STRING VARIABLES.
PICKLES
PRINT "X=";ASC(A$)
OK GUYS, HE'S GONE.
CASHEW BUTTER
FORA=1TO100:PRINT:NEXT
WE'VE GOT TO WORK FAST
CLS
I'LL CONNECT UP THIS MINI-MODEM.
????
HERE'S THE PHONE.
OK, HE NEEDS A DOZEN EGGS, TOMATOES, CARROTS, TUNA STICKS...
DIM
WAM
DAG-NABIT! THE PHONES BEING USED.
...AND THAT SHOULD BE ALL OF IT.
IFR=
GOTO
:END
WAM
BAM
BAM
OK. LETS GET GOING.
NEXT!
OH OH! HE'S COMING BACK.
WHATS GOING ON?
EVERYONE COOL IT.
WOW! THIS IS EXACTLY EVERYTHING I NEED.
DIP
ANT COLA
GEE HONEY, YOU REALLY DID A GOOD JOB OF BUYING THE GROCERIES.
THAT'S WHAT YOU THINK!
TOM SLOAN

Event Queue

August 1981

August-October

Writing for Results: A Course for Computer Professionals, various sites throughout the US. These courses are intended to help those in the computer field write clear and simple prose. Fees range from $490 to $660 for the weekend courses. For schedules of cities and dates, contact American Management Associations, 135 W 50th St, New York NY 10020, (212) 586-8100.

August 3-7

Workshops in Digital Sound Synthesis and Processing, Digital Music Systems Inc, Boston MA. These courses will provide a hands-on introduction for electronic-music composers and performers, recording engineers, psychoacoustic researchers, and others working in the digital-audio field. Fundamentals of digital audio, unit generators, automated synthesis and processing, nonlinear techniques, digital delay, filtering and reverberation, digital-audio hardware, and future trends in digital audio will be covered. The fee is $300. Contact Digital Music Systems Inc, POB 1632, Boston MA 02110, (617) 542-3042.

August 10-12

Financial Fundamentals Using Computers, Boston MA. This seminar will focus on the nonfinancial manager's needs to understand the fundamentals of accounting and finance in a computerized environment. Attendees will learn to use Apple II microcomputers for financial procedures and transactions. Registration fees are $795. Contact the American Institute for Professional Education, Carnegie Bldg, 100 Kings Rd, Madison NJ 07940, (201) 377-7400.

August 10-14

Reliability and Life Testing, UCLA, Los Angeles CA. Engineers and scientists involved with the reliability, design, product assurance, quality, and safety aspects of components, equipment, and systems are invited to attend this course. The fee is $775. Contact the Short Course Program Office, 6266 Boelter Hall, UCLA Extension, Los Angeles CA 90024, (213) 825-1047.

August 10-14

Workshops in Digital Sound Synthesis and Processing, Digital Music Systems Inc, Boston MA. For details, see August 3-7.

August 17-21

Workshops in Digital Sound Synthesis and Processing, Digital Music Systems Inc, Boston MA. For details, see August 3-7.

August 24-27

Software Design, Reliability, and Testing, Sheraton Motor Inn, Lexington MA. This four-day seminar for engineers, programmers, and technical managers examines concepts and techniques for developing and testing reliable, cost-effective software. Management concerns and recommended policies are also addressed. Tuition is $600, which includes course notes, luncheon, refreshments, and an evening reception. Contact Professor Donald D French, Institute for Advanced Professional Studies, One Gateway Ctr, Newton MA 02158, (617) 964-1412.

August 24-28

The Seventh International Joint Conference on Artificial Intelligence, University of British Columbia, Vancouver BC, Canada. This conference will examine computer applications of medical diagnosis, computer-aided design, robotics, programmable automation, speech understanding, vision, and other related topics. A tutorial program and artificial-intelligence exhibits will also be presented. For more information, contact Louis G Robinson, American Association for Artificial Intelligence, Stanford University, POB 3036, Stanford CA 94305, (415) 495-8825.

August 25-27

BASIC: A Computer Language for Managers, Sheraton Centre and the New York Hilton, New York NY. This course is for managers needing to learn the fundamentals of computers and programming. Programming basics, simple examples of BASIC programs, problem solving, and simulation modeling will be covered. Contact American Management Associations, 135 W 50th St, New York NY 10020, (212) 586-8100, ext 514.

August 25-28

Vector and Parallel Processors in Computational Science, Chester, England. The conference will concentrate on hardware, software, algorithms, applications, and case studies concerning vector and parallel processors. For details, contact Mrs S A Lowndes, Science Research Council, Daresbury Laboratory, Daresbury, Warrington, WA4 4AD, England.

August 26-29

The Fifth Annual National Small Computer Show, New York Coliseum, New York NY. Daily lectures and a five-hour executive-only seminar will be featured. The executive seminar is designed for upper-level managers who need an introduction to the understanding, acquisition, and use of computers in business. The registration fee for the show is $10 per day. The seminar for executives is $200, which includes all materials and show registration. For information, contact the National Small Computer Show, 110 Charlotte Pl, Englewood Cliffs NJ 07632, (201) 569-8542.

August 28-30

Personal Computer Arts Festival (PCAF '81), Philadelphia Civic Center, Philadelphia PA. PCAF '81 will include technical sessions, demonstrations, and exhibits. Also featured is the annual computer-music concert and computer-graphics film and video show. PCAF '81 is being held in conjunction with the Personal Computing Show '81. For complete details, contact PCAF '81, POB 1954, Philadelphia PA 19105.

September 1981

September-December

Four Seminars from Management Information Corporation (MIC), various sites throughout the US. These seminars are designed for businesspeople who need an introduction to system selection and use. For a complete schedule of seminars, fees, and locations, contact Carol Bell, c/o MIC, 140 Barclay Ctr, Cherry Hill NJ 08034, (609) 428-1020.

September 1-3

Computerized Office Equipment Expo (COEE), Civic Center, Atlanta GA. COEE provides a forum where the owners and executives of small and large businesses can learn about office automation. Office equipment for word processing, record storage and retrieval, and micrographics will be exhibited. Contact Cahners Exposition Group, 222 W Adams St, Chicago IL 60606, (312) 263-4866.

September 9-11

Eurographics '81, Technical University, Darmstadt, West Germany. Almost seventy exhibitors are expected to attend this computer-graphics show. Detailed information can be obtained from Diebold Deutschland GmbH, Attn: Dr H J Grobe, Feuerbachstrasse 8, D-6000 Frankfurt/Main, West Germany.

September 10-13

Mid-West Computer Show, McCormick Place, Chicago IL. This show features office systems, data- and word-pro-

cessing equipment, telecommunications equipment, microcomputers, computer graphics, peripherals, and other related supplies. For information, contact the National Computer Shows, 824 Boylston St, Chestnut Hill, MA 02167, (617) 739-2000.

September 14-17
Software Info '81, Merchandise Mart Expocenter, Chicago IL. The conference theme is "Productivity Through Packaged Software." Fran Tarkenton will be the keynote speaker. For more information, contact Software Info, 1730 N Lynn St, Suite 400, Arlington VA 22209, (703) 521-6209.

September 14-17
Productivity—An Urgent Priority, Capital Hilton Hotel, Washington DC. This conference is intended to provide a focus on productivity throughout the computer industry. General inquiries for program information should be addressed to Compcon Fall '81, POB 639, Silver Spring MD 20901, (301) 589-3386.

September 15-17
WESCON/81, Brooks Hall, Municipal Auditorium, and Hilton Hotel, San Francisco CA. Sessions on communications, components and devices, computer and microprocessor hardware and software, office automation, and memory systems will be presented. Exhibits of computer equipment and related products will be featured. Contact Electronic Conventions Inc, Suite 410, 999 N Sepulveda Blvd, El Segundo CA 90245, (213) 772-2965.

September 16-18
Diagnostic Software: Planning and Design, Boston MA. This seminar is directed toward the design, test, and diagnostic engineer and manager. Design examples, lectures, informal sessions, and individual and group diagnostic-programming sessions are part of the course. Tuition is $495. Contact Professor Donald D French, Institute for Advanced Professional Studies, One Gateway Ctr, Newton MA 02158, (617) 964-1412.

September 16-18
The Engineer as a Communicator, Crystal City Marriott, Arlington VA. This conference will feature discussions on communications technology, information gathering, storage, and retrieval, using computers in technical communications, and other related topics. Contact Dr Daniel Rosich, School of Business Administration, University of Connecticut, Stamford CT 06903, (203) 322-1673.

September 24-25
Microprocessors: Hardware, Software, and Applications, Worcester Polytechnic Institute, Worcester MA. Among the courses to be offered are hardware and software basics, selection and evaluation of microprocessors, memory and input/output systems, multiprocessor systems, real-time-system design, and debugging and circuit testing. For more information, contact Ginny Bazarian, c/o Worcester Polytechnic Institute, Worcester MA 01609, (617) 753-1411.

September 24-27
Mid-Atlantic Computer Show, Washington Armory, Washington DC. For details, see September 10-13.

September 30-October 2
Data and Telecommunications Expo '81, Rhein-Main-Halle, Wiesbaden, West Germany. This exhibition and conference will cover all areas of technology in data handling and distribution and telecommunications networks in office environments will also be discussed. Contact Cahners Exposition Group, 222 West Adams St, Chicago IL 60606, (312) 263-4866. In Europe, contact Kiver Communications S A, U K Brtanch Office, Millbank House, 171/185 Ewell Rd, Surbiton, Surrey, KT6 6AX, England.

October 1981

October 7-21
The 1981 Far East Computer Tour, Hong Kong, Japan, Korea, and Taiwan. This tour group visits various computer-related conferences and exhibitions throughout the Far East. Transportation for this three-week tour, plus shows, meals, and other items are included in trip packages, ranging in price from $2290 to $3095. For more information, contact Terry Butler, Commerce Tours International Inc, 870 Market St, Suite 742-744, San Francisco CA 94102, (415) 433-3072.

October 12-15
Information Management Exposition and Conference/INFO 81, Coliseum, New York NY. Discussions on prepackaged, customized prepackaged, and custom-designed software will complement hardware and software exhibits. For more information, contact Clapp & Poliak Inc, 245 Park Ave, New York NY 10167, (212) 661-8410.

October 19-23
Systems 81, Munich, West Germany. Computer systems and their applications will be featured. Additional information is available from Kallman Associates, 30 Journal Sq, Jersey City NJ 07306, (201) 653-3304.

October 20-22
Computertized Office Equipment Expo/Southwest, Astrohall, Houston TX. Approximately 100 exhibitors will present office equipment and supplies, including word-processing systems, at this show. Contact Industrial Scientific and Conference Management Inc, 222 W Adams St, Chicago IL 60606, (312) 263-4866.

October 21-24
Computa 81, World Trade Center, Singapore. This international show attracts professionals and buyers from Hong Kong, India, and Sri Lanka. Additional information can be obtained from Kallman Associates, 30 Journal Sq, Jersey City NJ 07306, (201) 653-3304.

October 25-30
The Information Community: An Alliance for Progress, Washington DC. This conference provides a forum for professionals in information technology, research operations, management, and education. The technical program includes presentations, contributed papers, special-interest group sessions, exhibits, and more. Contact the American Society for Information Science, 1010 16th St, NW, Washington DC 20036, (202) 659-3644.

October 27-29
Computer Graphics 81, Regent Centre Hotel, London, England. Conference topics include graphics systems hardware and software, animation, image processing, simulation, business graphics, and home graphics. An equipment exhibition will also be presented. Contact Online Conferences Ltd, Argyle House, Northwood Hills, Middlesex, HA6 1TS, England. ■

In order to gain optimal coverage of your organization's computer conferences, seminars, workshops, courses, etc, notice should reach our office at least three months in advance of the date of the event. Entries should be sent to: Event Queue, BYTE Publications, 70 Main St, Peterborough NH 03458. Each month we publish the current contents of the queue for the month of the cover date and the two following calendar months. Thus a given event may appear as many as three times in this section if it is sent to us far enough in advance.

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Microsoft Editor/Assembler Plus

Keith Carlson, 43 McDill Rd, Bedford MA 01730

When I opened the manual for Microsoft's Editor/Assembler Plus, I felt like crying. I had just spent a hard-earned $29.95 for Radio Shack's original Editor/Assembler, and now I felt cheated. It has been my experience with electronics that no matter what I buy, the price goes down soon after I buy it. Perhaps the old cliché *is* true: all things come to he who waits.

The price for Editor/Assembler Plus is actually the same as the earlier version, but its value has increased enormously. This is what prompted me to consider wreaking havoc on nearby inanimate objects. As I read the manual and discovered its extensively upgraded features, however, my resentment and frustration turned to delight. Microsoft had turned my Level II 16 K TRS-80 into a full-blown assembly-language development system, something that Radio Shack had failed to do.

The features of Editor/Assembler Plus are those of a much larger machine. There are some limitations, but the result satisfies my need to economize by squeezing every last drop of value out of my TRS-80.

It helped that one of the authors of Editor/Assembler Plus, Mark L Chamberlin, wrote Radio Shack's Editor/Assembler. Both authors have previous experience with the TRS-80 and probably were involved with the design of Level II BASIC.

After all the plaudits, however, some problems remain. One of the major problems is documentation.

Documentation

The documentation, fine as far as it goes, is definitely not enough. The manual was written by William Barden Jr, who has written several other books on both the TRS-80 and the Zilog Z80 microprocessor. Helpful hints and warnings are printed throughout the manual. They deal with the problem of printing a screen full of information in a book that measures only 4 ¾ by 6 ½ inches. There are also copious notes explaining that Shift-Up Arrow was printed as $ on the screen in the Z-BUG debugging mode. The text is simple and easy to read with plenty of illustrations and examples included. The only problem is the assumption that the reader has had previous experience with Radio Shack's Editor/Assembler and assembly-language coding.

In fact, that assumption pervades Microsoft's attitude about Editor/Assembler Plus. When I bought Radio Shack's Editor/Assembler, I received all the goodies, such as the instruction-set data, *Z80 Micro-Reference Manual*, and some handy ROM (read-only memory) entry points. All these are conspicuously absent from Editor/Assembler Plus. People having an interest in assembly-language programming would buy Editor/Assembler Plus instead of Editor/Assembler. Doing so, though, would leave them wondering where the rest of the documentation was. Luckily, auxiliary documentation is available at low cost elsewhere (Radio Shack's new T-BUG manual, for example). However, this kind of information should have been included by Microsoft.

Other documentation is also needed. There is *no* documentation concerning Editor/Assembler Plus itself. The manual doesn't even give the load address, ending address, or entry address! If it weren't for the errata sheet included, it would be irritating and time-consuming to find the proper addresses needed to make a backup copy. A backup copy is a necessity, especially when you are using ordinary cassette tapes. It would be even more convenient to have certain entry points available to make modifications, such as adding a hard-copy print routine, which is sadly lacking in Z-BUG.

In these times of software piracy, it is easy to understand why Microsoft is highly protective of its software. But it doesn't explain why it won't even sell documentation! In short, the existing documentation is adequate for anyone who is merely an end user of Editor/Assembler Plus, as long as the additional Z80 instruction-set documentation is available.

At a Glance

Name
Editor/Assembler Plus

Type
Assembly-language development package, including a Z80 macro assembler, line-oriented text editor, and interactive debugger

Manufacturer
Microsoft Consumer Products
10800 NE Eighth, Suite 507
Bellevue WA 98004
(206) 454-1315

Price
$29.95

Format
Cassette tape

Language
Z80 machine language

Computer
Radio Shack TRS-80 Level II with at least 16 K memory

Documentation
112 pages softcover, 4 ¾ by 6 ½ inches; Quick Reference Card

Audience
TRS-80 assembly-language programmers

Editor

The editor, which was adequate before, is better now. The functions remain much the same as in Editor/Assembler, but new power and versatility have been added through the extension of the range and line-number specifications. They are a necessity in a line-oriented editor.

Where there was only one way to specify a range of line numbers, there are now four. You can specify a range by two line numbers separated by a colon, a line number followed by the number of lines separated by an exclamation mark, an offset (either plus or minus), or no line number at all. Also, these specifiers can be used in any editing-command parameter requiring a line number, allowing various combinations. They can even be used in the E(dit) command to edit a set of contiguous lines without constantly entering the Edit command. The F(ind) command accepts a range, searches for a string over that range (the whole buffer, if necessary), and finds every occurrence, not just the first. While range specification greatly extends the versatility of both the editor commands and subcommands, more was needed to produce a top-notch editor, and Microsoft responded.

Editor/Assembler Plus adds five new commands that further increase the editor's efficiency. The first two are related: M(ove) and C(opy). Copy merely duplicates a specified range of lines to another range. Move duplicates the lines and also deletes the source lines. To add to the power of these commands, you can specify a new line increment for the destination code. The S(ubstitute) command has the capability to substitute all occurrences in a range. This feature is useful when you have to change some labels or have finally realized that RET, not RTN, is the mnemonic for return. The X(eXtend) command is useful for adding comments to finished programs.

The frosting on the cake is the Q(uash) command. It allows you to delete either Z-BUG or both the assembler and Z-BUG from memory, increasing the editor-buffer space. Quashing Z-BUG presents certain problems since debugging is difficult without it, to say the least. Microsoft has an answer in the form of a stand-alone Z-BUG on the other side of the cassette. Quashing the assembler usually results in a source file that is too large to assemble in 16 K bytes, but it leaves plenty of room for general text editing.

Assembler

The assembler portion of this package unlocks the machine-language power of the TRS-80. In addition to interesting new ways to set the origin of the assembly code, the assembler now supports assembly into memory. Also, the assembler supports macroinstructions and conditional assembly. This lets my "plain old" Level II 16 K-byte machine become a powerful assembly-language development system; before and after is like Clark Kent and Superman.

The inconvenience of writing object code to tape and then reloading it (usually with a monitor program like T-BUG or RSM-2) is gone. An assembler switch (option) signifies that the object code is to be loaded into memory where it can be run under Z-BUG. The origin of the code is automatically set by the assembler at the end of the text buffer, which is variable in size (it must be, but the documentation is unclear on this point). That's where the difficulty comes. Suppose the buffer is filled with a 3 K-byte source file. That represents around 60 lines of 50 bytes, including comments—not unreasonable. If there are fifteen labels, the symbol table is a maximum of 135 bytes. Since the text buffer starts at location hexadecimal 7263 and the text buffer is 3 K bytes long, that leaves 412 bytes for the symbol table and object code in a 16 K-byte machine. This may be enough for most programs, but the only alternative is to quash Z-BUG, write the object code to tape, reload the stand-alone Z-BUG, and load the object code again. This defeats the in-memory assembly. If you have more than 16 K bytes of memory, the problem becomes trivial. The ORG statement should not be used for automatic origin as it will add the address given in the origin statement to the automatic origin.

If you want to choose that automatic origin, another assembler switch allows you to set it. This may be helpful when you want to debug the code at its actual location. The last new assembler switch allows for an absolute origin. In this case, an ORG statement must be used. This is the default for all assemblies to tape. It is possible to have an in-memory assembly with an absolute origin, but it is not recommended. To overcome this, set the automatic origin as in the manual and use the manual-origin assembler switch.

These additions are efficient and pleasing, but the most interesting features are macros (macroinstructions) and conditional assembly. These two features contribute most of the power to Editor/Assembler Plus.

This is probably why Barden spends an entire chapter on macros. Macros in the Editor/Assembler Plus resemble those of much larger machines. Several rules apply, but they are very reasonable. The manual states that there can be "...any reasonable number of macro definitions..." and "...each macro definition may have many arguments...." Since this is rather vague, I assume that they are limited by available space. Macros must be defined before they are referenced, so it is wise to define all macros at the beginning of the source text. Parameters can be passed to the macro, but the manual doesn't state whether a macro reference can be passed. I tried it, and found they can't. This is logical since nested macros are not allowed. Editor/Assembler Plus does allow synthetic labels in order to avoid doubly defined labels upon expansion. Barden gives several examples to demonstrate possible uses of the macro facility. He uses the longstanding practice of using macros for subroutine calls. He also demonstrates the use of macros to build a cross-assembler for the Motorola 6800 microprocessor (I used them to work on an Intel 8080 assembly-language translator). These examples are only a small portion of the numerous uses.

The conditional-assembly facility is explained as a tool for production of software for different configurations.

Even though this is the only example, it is still impressive. It is nice to have if you need it, but most users don't. Its use is extended greatly by the updated expression evaluation, which adds operators for logical, arithmetic, and parenthesized operations. The flexibility is enhanced by the ability to nest conditions.

The symbol table adds codes to indicate how labels are defined (or undefined). One thing that is lacking is a cross-reference facility for the symbol table. While not necessary, a cross-reference is extremely helpful. Unfortunately, it is expensive in overhead code.

Z-BUG

Z-BUG is a new item, rather than an update of part of a previous system. It only remotely resembles Radio Shack's T-BUG. In fact, this debugger is one of the best I've seen, presenting an exceptional value. The editor, assembler, and debugger come in one package for the price of Radio Shack's Editor/Assembler. If you add T-BUG, which is inferior to Z-BUG, you have a bigger bill. Z-BUG can't do everything, but it can do many interesting and helpful things. It can display and modify memory in several modes, set up to eight breakpoints, single-step through machine-language programs, act like a calculator, and reference the symbol table so you can use symbolic references when you are debugging.

First, let's see what Z-BUG can't do. My main complaint is that it cannot provide hard copy. It seems like such a simple task to have the displays shuttled off to the printer. Combine this with the fact that there are no entry points given for the program itself and you have a frustrating and time-consuming task if you want to correct the omission. My only suggestion is to place a print driver somewhere in memory so you can use the $G command to jump to it and then have it return to the beginning of Editor/Assembler Plus. The "Quick Reference Card" indicates that an entry point is provided that does not destroy the contents of the buffer.

My second complaint is the lack of a routine to disassemble to tape. That would be handy if you had an object module without the source code. It also might be useful for modifying a routine provided in ROM. You couldn't replace it in ROM, of course, but there are many routines already worked out if you can get to them.

Now, what can Z-BUG do? It's truly amazing what they can do at Microsoft. There are four modes in which you can examine memory: mnemonic, byte, word, and ASCII. Each one is descriptive of what is displayed. To open any memory location for display, just type its location followed by a slash. You can then examine the location and type in a new value, as you like. If you use the Down Arrow key, it automatically opens the next location, dependent on the mode you are in. If in byte mode, the next byte; if in word mode, the next word; if in mnemonic mode, the next instruction, and so on. To close the location and end the parade of locations, type Enter and Z-BUG responds with its prompt. The process is simple and convenient. Z-BUG doesn't stop there, however. You can easily set the input and output radices. This allows, say, decimal input and hexadecimal output or almost any other combination between base 2 and base 16. You can also modify any of the registers (except the refresh register) after they are displayed. There are several commands to get a one-time display in a different mode.

If you liked that, you'll love the fact that you can set up to eight breakpoints. Each one is numbered automatically. You can examine locations and registers and even modify them before continuing the program. You can also specify the number of times the breakpoint is passed before it stops the program. Single stepping can be ordered after a breakpoint or all by itself. You can also reference your breakpoints and single-stepping entry points by symbolic reference.

Symbolic reference can be used throughout the program with any command. You can set the mode to $S, denoting symbolic reference, or just use them. If you are not in symbolic mode, any nonnumeric input sends Z-BUG to the symbol table to resolve the address associated with that reference. In fact, you can use any standard suffix (such as T for decimal, H for hexadecimal, etc) no matter what the radix is set to and the program resolves it. And if it isn't flexible enough, it also works as a calculator, doing all your arithmetic in any base between 2 and 16.

I am quite impressed with Z-BUG. It is an extremely flexible debugging tool. However, there are two minor problems that need pointing out. First, if you have to use the stand-alone version of Z-BUG, you won't be able to use symbolic references. This is because Z-BUG resolves symbolic references by a look at the symbol table. When you reload the object module, you don't have the symbol table to look at. Second, the manual suggests that you use a dummy address for the entry or execution address when you punch out a system tape if you don't have one. *Don't do it!* When you read it back in under SYSTEM and type the slash to start it, it tries to start it at the dummy address. Instead, use the starting address for the entry address. It will avoid problems when you try to run the program you spent two days on.

Conclusions

Microsoft's Editor/Assembler Plus is an excellent editor/assembler/debugger. It has a few problems that prevent it from being outstanding. It can turn any Radio Shack TRS-80 Level II with at least 16 K bytes of memory into an assembly-language development system with little effort. Microsoft has learned from the problems and complaints that came from the users of Radio Shack's Editor/Assembler.

Documentation has usually been a problem with Microsoft products, and that has not changed with Editor/Assembler Plus. There is a definite lack of support documentation with the package. The documentation that is included is well done.

Editor/Assembler Plus is an outstanding value for its price. Not only is an editor and macro assembler included in the package, but a powerful debugger as well. ■

BOSS:
A Debugging Utility for the TRS-80 Model I

Scott Mitchell, 346 S Taylor St, Manchester NH 03103

BOSS is a utility program to help debug programs written in TRS-80 Microsoft BASIC by dynamically tracing steps in execution. Essentially, this program intercepts the TRACE function included with TRS-80 BASIC and modifies its operation. The result is a more versatile debugging utility with a more meaningful and readable screen display.

The first thing you notice after BOSS is loaded is that the line numbers normally output by the TRACE function no longer print all over the screen, making the display scroll uncontrollably. The trace-line numbers now print in a vertical column in the upper right-hand part of the screen. Four line numbers are displayed, with an arrow pointing to the one currently executing. This is a big advantage when trying to debug a graphics program or any program that specially formats information output to the screen. With BOSS, all the graphics and formatted information stay where they should; BOSS doesn't destroy or interfere with the video output of the program being debugged.

The numbers of the program lines being traced may be output to a printer, if necessary. The functions of tracing and sending the trace-line numbers to the video display or printer can be controlled either manually during the program execution and debugging, or by POKE commands within the program being tested. Using the POKE commands, you can start and stop BOSS functions at points specified by the program being traced.

BOSS stands for BASIC Operated Single Stepper, meaning that instead of watching your regular trace whiz by, you can slow down or single-step the trace. You can step through the program line by line, or in the case of multi-instruction lines, instruction by instruction. Tracing a program is made much easier.

Variables can be examined any time, and BOSS lets you tell it which ones you're trying to keep track of. Once you've told BOSS what you want, pressing two control keys lists out the variables and their contents.

You can also stack programs in memory to the extent of memory available. With this function, you can append one program with others quite easily. You load a program and give the command to push it to locations high in memory. BOSS does this and resets the pointers for the new limits of your BASIC source-code buffer. Now, load a second program and give the command to append it with the first program. BOSS is happy doing its own memory management. It checks the amount of memory you have and keeps track of how much you have used or will need. BOSS asks how much memory to protect and locates itself just under your stated protected-memory limit. It also tells what memory size to give when you enter BASIC. The BOSS program has no problem working with either a TRS-80 Level II cassette system or the TRSDOS disk operating system.

BOSS did lock up on me sometimes, but this was mostly because I did not follow directions. For instance, I did not set a memory size, or I pressed the control keys to send output to the printer when no printer was on line.

Overall, BOSS has many good features, with only a few bad ones. Since it works so well, BOSS has become one of my most used BASIC utilities.■

At a Glance

Name
BOSS (BASIC Operated Single Stepper)

Type
Debugging utility (replaces the TRACE function)

Distributor
Level IV Products Inc
32238 Schoolcraft
Livonia MI 48150
(800) 521-3305

Price
$29.95

Format
5-inch floppy disk or cassette tape

Language used
Z80 machine language

Computer needed
TRS-80 Model I, minimum of 16 K bytes of memory, cassette or disk based

Documentation
13-page pamphlet

Audience
TRS-80 BASIC programmers dissatisfied with the operation of the present TRACE function

Indirect I/O Addressing on the 8080

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It is frequently useful to be able to specify the address of an I/O (input/output) port by the contents of a register or memory location, to allow a common I/O routine to service a number of similar devices connected to separate ports. If you have a system based on Intel's 8080 microprocessor that does not have memory-mapped I/O, you cannot do this using the 8080 I/O instructions in the normal manner, because only direct addressing is allowed for I/O instructions.

One solution is to modify the I/O instruction each time, prior to executing it, so it addresses the required port. Two possible problems with this method are:

- the program will not work if stored in ROM (read-only memory) since the instructions cannot be modified
- the program is not reentrant, which makes simultaneous I/O to several ports impossible (as in multiprogramming or multitasking)

For the program to be reentrant, it must store variable data either in the processor's registers or in memory locations assigned at execution time. If the I/O instruction could be regarded as a variable and stored in this manner (but also executed as though it were part of the program), we could solve the two problems mentioned above.

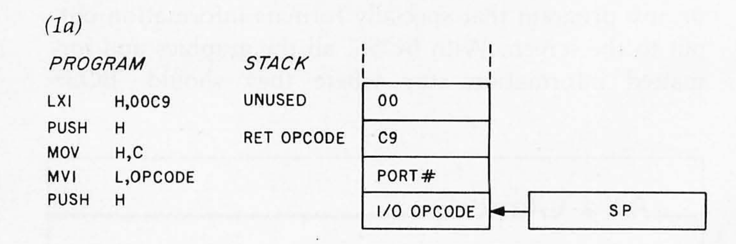
Enter the Stack

The stack is an area of programmable memory that is dynamically assigned at execution time and is present in most 8080 systems; thus, it is ideal for this application.

In the method presented here, we assemble the I/O instruction code in the processor's registers and store it on the stack together with a RET (subroutine return) instruction. Then it is called as though it were a subroutine, and, finally, the instructions are cleared from the stack (see figure 1).

One problem with calling a subroutine on the stack is that its *absolute start address* cannot be predicted when

(1a)



(1b)

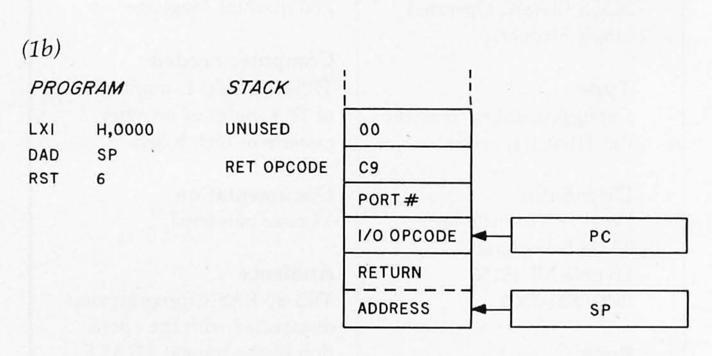


Figure 1: *Stages in the assembly and execution of an indirect I/O subroutine. The C register is assumed to contain the I/O port address. Figure 1a shows how the code is assembled in the registers and pushed onto the stack. In figure 1b, the start address for the code on the stack is loaded into the HL register pair and an indirect subroutine call is performed.*

Listing 1: *Subroutines for performing indirect input and output operations. With the I/O port address stored in the C register, data is transferred to (or from) register A, as with normal 8080 I/O instructions.*

(1a)

```
                               ;P6S1
                               ;= = = =
                               ;DATE: 21/7/1980                    INDIRECT INPUT SUBROUTINE.

0000    21C900   INPUT         LXI    H,0C9H
0003    E5                     PUSH   H           ;STORE "RET" OPCODE ON STACK.
0004    61                     MOV    H,C
0005    2EDB                   MVI    L,0DBH
0007    E5                     PUSH   H           ;STORE "IN" OPCODE ON STACK.
0008    210000                 LXI    H,0
000B    39                     DAD    SP          ;MOVE SP TO HL.
000C    F7                     RST    6           ;CALL TO ADDRESS IN HL.
000D    E1                     POP    H           ;CLEAR STACK.
000E    E1                     POP    H
000F    C9                     RET

                               END
```

(1b)

```
                               ;P6S2
                               ;= = = =
                               ;DATE: 21/7/1980                    INDIRECT OUTPUT SUBROUTINE.

0000    21C900   OUTPUT        LXI    H,0C9H
0003    E5                     PUSH   H           ;STORE "RET" OPCODE ON STACK.
0004    61                     MOV    H,C
0005    2ED3                   MVI    L,0D3H
0007    E5                     PUSH   H           ;STORE "OUT" OPCODE ON STACK.
0008    210000                 LXI    H,0
000B    39                     DAD    SP          ;MOVE SP TO HL.
000C    F7                     RST    6           ;CALL TO ADDRESS IN HL.
000D    E1                     POP    H           ;CLEAR STACK.
000E    E1                     POP    H
000F    C9                     RET

                               END
```

Listing 2: *A simulated indirect subroutine call. A call to this subroutine causes a jump to the address contained in the HL register pair.*

This code is necessary for the indirect subroutine call. It consists of a single indirect jump instruction, located at address 0030H, which is executed when the RST 6 instruction is performed.

```
                               ;P6S3
                               ;= = = =
                               ;DATE: 21/7/1980                    INDIRECT SUBROUTINE CALL.

0030    E9                     PCHL               ;JUMP TO ADDRESS IN HL.

                               END
```

the program is written. Thus, we need an indirect subroutine call—something the 8080 microprocessor does not have. This can be simulated by a call to a subroutine that causes a jump to an address contained in the HL register pair (shown as an RST 6, but it could be an ordinary subroutine).

After the assembled code is pushed onto the stack, SP points to the first byte of the I/O subroutine. SP is loaded into HL and an indirect call is performed. The stack now appears as figure 1b, with the return address at the top and the PC (program counter) pointing to the first byte of the I/O subroutine. The 3 bytes of code on the stack are then executed. The RET instruction causes the return address to be popped off the stack and execution continues within the main body of the program.

Listings 1a and 1b show subroutines for performing indirect input and output operations, respectively. They are both relocatable and reentrant and can reside in either programmable or read-only memory.

Both subroutines shown assume that register C contains the I/O port address. Data is loaded into register A or stored from register A, as with the normal 8080 I/O instructions. The only other registers modified are H and L.

Indirect subroutine calls are also useful in other applications where it is desired to specify the start address of a subroutine at execution time.■

Programming Quickies

A Disk Catalog for the Eighties

Bob Liddil, POB 66, Peterborough NH 03458

DISK/CAT, a NEWDOS-based, commercial-quality cataloging program for a Radio Shack TRS-80 with two or more drives, performs several useful services (see listing 1). In addition to recording and filing the contents of every disk run through it, the program assigns to each a permanent number (which is placed in the directory). Updating is performed by simply reinserting the disk and running DISK/CAT again. The contents of the disk are then recataloged, and file names are deleted or added while retaining the number.

DISK/CAT can remember a particular program and report its whereabouts, on a disk-by-disk basis, repeating all occurrences of the program. The search routine can be initialized from the beginning or from the end.

The display mode will print all disk directories to the screen (or to a printer, see listing 2a), give the directory of any specified disk, or alphabetize all file names and print them to screen or printer with their disk number (see listing 2b). ■

Listing 1: *DISK/CAT for the Radio Shack TRS-80. The program numbers each disk, and catalogs its contents. The stored files can be printed or displayed on the video monitor in alphabetical order or on a disk-by-disk basis.*

```
5  GOSUB5ØØ:
     CLS:
     CLEAR5ØØØ:
     PRINT@276,"        DO YOU WANT TO
     1   CATALOG A NEW DISK OR UP DATE
     OLD DISK       2    LOOK    AT PROGRAM
     FILE OR SEARCH FOR PROGRAM";
1Ø  A$=INKEY$:
     IF A$="" THEN GOTO 1Ø
15  A=VAL(A$):
     IF A<1 OR A>2 THEN GOTO 1Ø
2Ø  ON A GOTO 25,2ØØ
25  TROFF:
     CLS:
     GOSUB 395:
     CLS:
     PRINT@512,"PLEASE INSERT THE DISK
     TO BE CATALOGUEDIN DRIVE #";DK;
     " AND PRESS   <ENTER> ";
3Ø  QQ$=INKEY$:
     IF QQ$=""THEN GOTO 3Ø
35  DIMA$(5Ø):
     CLS:
     GOSUB42Ø:
     N=1536Ø+(63*2)+2
4Ø  X=PEEK(N):
     IFX<>32ANDPEEK(N-1)=191THENI=I+1:
     C=Ø
45  IFC>3ØTHEN7Ø
5Ø  IFN>16382THEN7Ø
55  IFX=32THENPOKEN,191:
     N=N+1:
     C=C+1:
     GOTO4Ø
6Ø  POKEN,191:
     POKEN,X:
     A$(I)=A$(I)+CHR$(X):
     N=N+1:
     IFC>3ØTHEN7Ø
65  IFN<16382THEN4Ø
7Ø  CLS:
     FORX=0TOI:
     IFA$(X)="P"ORA$(X)="NUMBER"THEN
     A$(X)=CHR$(191):
     GOTO8Ø
75  PRINTA$(X),:
     IFPOS(Ø)+LEN(A$(I+1))+9>64THEN
     PRINT
```

```
80 NEXT:
    ONERRORGOTO85:
    OPEN"I",1,"DN:0":
    INPUT#1,DH:
    CLOSE:
    GOTO90
85 CLOSE:
    OPEN"O",1,"DN:0":
    PRINT#1,0:
    CLOSE:
    RESUME
90 ONERRORGOTO100:
    OPEN"I",1,DK$:
    INPUT#1,DN:
    CLOSE:
    SK=DN:
    IFDH>DNTHEN115
95 OPEN"O",1,"DN:0":
    PRINT#1,DN:
    CLOSE:
    GOTO115
100 CLOSE:
    OPEN"I",1,"DN:0":
    INPUT#1,DN:
    CLOSE:
    OPEN"O",1,DK$:
    PRINT#1,DN+1:
    CLOSE:IFDN+1<=DHTHEN110
105 OPEN"O",1,"DN:0":
    PRINT#1,DN+1:
    CLOSE
110 RESUME
115 ONERRORGOTO140:
    CLOSE:
    CLS:
    PRINT"THIS IS DISK #";DN:
    OPEN"I",1,"FILE:0":
    INPUT#1,NP:
    DIMN$(NP+I+1),D(NP+I+1),O(NP+I+1):
    IFNP=0THEN130
120 FORX=1TONP:
    INPUT#1,N$(X):
    NEXT:
    CLOSE:
    ONERRORGOTO0:
    OPEN"I",1,
    "FILEO:0":
    FORX=1TONP:
    INPUT#1,D(X):
    IFD(X)=SKTHENN$(X)=CHR$(191)
125 NEXT
130 CLOSE:
    ONERRORGOTO0:
    X=NP:
    N=0:
    CLS:
    FORL=X+1TOX+I+1:
    N$(L)=A$(N):
    N=N+1:
    D(L)=DN:
    NEXT:
    NP=NP+I+1:
    FORI=1TONP:
    O(I)=I:
    NEXT:
    GOSUB145:
    FORX=1TONP:
    IFN$(O(X))<>CHR$(191)THENNP=X
135 NEXT:
    OPEN"O",1,"FILE:0":
    PRINT#1,NP:
    FORI=1TONP:
    PRINT#1,N$(O(I)):
    NEXT:
    CLOSE:
    OPEN"O",1,"FILEO:0":
    FORI=1TONP:
    PRINT#1,D(O(I)):
    NEXT:
    CLOSE:
    GOTO5
140 CLOSE:
    OPEN"O",1,"FILE:0":
    PRINT#1,0:
    CLOSE:
    RESUME
145 L=1:
    C=0:
    FORN=1TONP:
    IFN$(O(N))=CHR$(191)THENC=C+1
150 NEXT:
    FORX=1TONP-C-1:
    IFN$(O(X))=CHR$(191)THENGOSUB160
155 NEXT:
    GOTO165
160 CLS:
    PRINT"PRE SORT":
    A=O(X):
    FORN=XTONP-1:
    O(N)=O(N+1):
    NEXT:
    O(NP)=A:
    X=X-1:
    RETURN
165 C=0:
    FORX=LTONP-1:
    IFN$(O(X))>N$(O(X+1))THENGOSUB175:
    X=NP-1:
    NEXT:
    GOTO165
170 L=X:
    NEXT:
    TROFF:
    RETURN
175 CLS:
    PRINT"SORTING DATA":
    FORI=X+1TO1 STEP-1:
    IFN$(O(I))<N$(O(I-1))THENA=O(I):
    O(I)=O(I-1):
    O(I-1)=A:
    C=1
180 IFC=0THENI=1:
    NEXT:
    GOTO190
185 C=0:
    NEXT
```

Listing 1 continued on page 406

Listing 1 continued:

```
190 L=L-1:
     IFL<1THENL=1
195 RETURN
200 ONERRORGOTO5:
     OPEN"I",1,"FILE:0":
     INPUT#1,NP:
     DIMN$(NP),D(NP):
     FORX=1TONP:
     INPUT#1,N$(X):
     NEXT:
     CLOSE:
     OPEN"I",1,"FILEO:0":
     FORX=1TONP:
     INPUT#1,D(X):
     NEXT:
     CLOSE:
     OPEN"I",1,"DN:0":
     INPUT#1,DN:
     CLOSE
205 CLS:
     PRINT"DO YOU WANT TO1   SEARCH
     FOR PROGRAM        (N) CHAR. FROM
     BEGING2  SEARCH       (N) CHAR. FROM
     END3           PRINT ALL DISKS TO
     PRINTER4            PRINT ALL DISKS TO
     SCREEN
210 PRINT"5            ALL PROGRAMS TO PRI
     NTER IN ALPH. ORDER  WITH DISK#":
     PRINT"6            DIR OF ANY DISK":
     PRINT"7            RESTART8           END
215 QQ$=INKEY$:
     IF QQ$=""THEN GOTO 215
220 FL=VAL(QQ$):
     IF FL<1 OR FL>8 THENGOTO 215
225 ON FL GOTO230,300,335,345,360,365,
     5,390
230 CLS:
     PRINT"YOU GIVE ME ANY NUMBER OF
     CHAR. I WILL LIST ALL DISKSTHAT
     CONTAIN A PROGRAM THAT START WITH
     THOSE CHAR.":INPUT"CHAR. TO SEARCH
     FOR";A$:L=LEN(A$):PRINT"OUTPUT TO
     PRINTER      Y/N"
235 P$=INKEY$:
     IF P$=""THEN GOTO 235
240 IF P$="Y"THEN P=1:
     GOTO255
245 IF P$="N"THEN P=0:
     GOTO255
250 GOTO235
255 CLS:
     P$="":
     FORX=1TONP:
     IFLEFT$(N$(X),L)=A$THEN265
260 GOTO280
265 IFP=1THEN275
270 PRINTN$(X),"DISK #";D(X):
     GOTO280
275 LPRINTN$(X),"DISK #";D(X)
280 NEXT
285 PRINT@980,"PRESS <ENTER> TO CONT
     INUE";
290 QQ$=INKEY$:
     IF QQ$="" THEN GOTO 290
295 GOTO 205
300 CLS:
     PRINT"YOU GIVE ME ANY NUMBER OF
     CHAR.I WILL LIST ALL THE PROGRAMS
     THAT END IN THOSE CHAR.":INPUT"TO
     SEARCH FOR----";A$:
     L=LEN(A$):PRINT"OUTPUT TO PRINTER
     Y/N  "
301 P$=INKEY$:
     IFP$=""THEN 301
302 IF P$="Y"THEN P=1:
     GOTO305
303 IF P$="N"THEN P=0:
     GOTO305
304 GOTO 301
305 CLS:
     FORX=1TONP:
     IFRIGHT$(N$(X),L)=A$THEN315
310 GOTO330
315 IFP=0THEN325
320 LPRINTN$(X),"DISK #";D(X)
325 PRINTN$(X),"DISK #";D(X)
330 NEXT:
     GOTO285
335 OPEN"I",1,"DN":
     INPUT#1,DN:
     CLOSE:
     FORX=1TODN:
     LPRINT"  ":
     LPRINT"  ":
     LPRINT"------------DISK #";X;
     " -----------------":
     LPRINT"  ":
     FORN=1TONP:
     IFD(N)=XTHENLPRINT"                ";
     N$(N)
340 NEXT:
     NEXT:
     GOTO285
345 FORX=1TODN:
     CLS:
     PRINT"DISK #";X:
     PRINT:
     PRINT:
     PRINT:
     FORN=1TONP:
     IFD(N)<>XTHEN355
350 PRINTN$(N),:
     IFPOS(0)>50THENPRINT
355 NEXT:
     PRINT:
     PRINT:
     FORI=1TO2000:
     NEXT:
     NEXT:
     GOTO205
360 CLS:
     FORX=1TONP:
     LPRINTN$(X),"DISK    #";D(X):
```

```
    PRINTN$(X),"DISK     #";D(X):
    NEXT:
    GOTO2Ø5
365 CLS
37Ø INPUT"DIR OF WHAT DISK";D:
    IFD>DNTHENPRINT"DISKS ONLY CATALOG
    ED UP TO ";DN:
    GOTO37Ø
375 CLS:
    PRINT"DISK     #";D:
    PRINT:
    FORX=1TONP:
    IFD(X)=DTHENPRINTN$(X),
38Ø IFPOS(Ø)>5ØTHENPRINT
385 NEXT:
    GOTO285
39Ø END
395 CLS:
    PRINT"ON WHICH DRIVE (1 THRU 3)
    WILL YOU PLACE YOUR DISK TO BE
    CATALOGED?":
    LINEINPUT DK$
4ØØ DK=VAL(DK$):
    IF DK<1 OR DK>3 THEN CLS:
    GOTO395
4Ø5 IF DK=1 THEN DK$="NUMBER:1":
    RETURN
41Ø IF DK=2 THEN DK$="NUMBER:2":
    RETURN
415 IF DK=3 THEN DK$="NUMBER:3":
    RETURN
42Ø IF DK=1THEN CMD"DIR :1":
    RETURN
425 IF DK=2THEN CMD"DIR :2":
    RETURN
43Ø IF DK=3THEN CMD"DIR :3":
    RETURN
5ØØ CLS:
    PRINTCHR$(23):
    PRINT@24,"NOTICE":
    PRINT:
    PRINT"THIS PROGRAM WILL NOT WORK
    WITH A SINGLE DRIVE DISK SYSTEM"
51Ø FOR ZZ=1TO 15ØØ:
    NEXT:
    RETURN
```

Listing 2: *Sample printer output from DISK/CAT. The directories of all disks, in disk-number order, are shown in listing 2a; listing 2b shows the directories in alphabetical order.*

(2a)

```
-------------DISK # 1  ------------------

            BARTEND
            DISKED35/CMD
            FCC1
            FCC2
            FCC3
            FCC4
            FCC5
            TEMP1

-------------DISK # 2  -----------------

            DSHIP/CMD
            DUTCHMAN
            INTRO
            SPIDER

-------------DISK # 3  -----------------

            DSHIP/CMD
            STARTREK

-------------DISK # 4  -----------------

            CATALOG
            DECODE
            ETCH/PCL
            LCPRINT/CMD
            LETTER
            PENCIL/CMD
            REPORT/PCL
            TEST
            VOICE
```

(2b)

```
BARTEND         DISK   # 1
CATALOG         DISK   # 4
DECODE          DISK   # 4
DISKED35/CMD    DISK   # 1
DSHIP/CMD       DISK   # 2
DSHIP/CMD       DISK   # 3
DUTCHMAN        DISK   # 2
ETCH/PCL        DISK   # 4
FCC1            DISK   # 1
FCC2            DISK   # 1
FCC3            DISK   # 1
FCC4            DISK   # 1
FCC5            DISK   # 1
INTRO           DISK   # 2
LCPRINT/CMD     DISK   # 4
LETTER          DISK   # 4
PENCIL/CMD      DISK   # 4
REPORT/PCL      DISK   # 4
SPIDER          DISK   # 2
STARTREK        DISK   # 3
TEMP1           DISK   # 1
TEST            DISK   # 4
VOICE           DISK   # 4
```

DISK/CAT was written by David Huntress of Boston MA. Enhancements were added by Reese Fowler of Peterborough NH. Copies are available on tape for disk BASIC from The Programmer's Guild, POB 66, Peterborough NH 03458, for $19.95.

Alpha-Beta Tree Search Converted to Assembler

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In part three of his article "Machine Problem Solving" (November 1980 BYTE, page 224), Peter Frey discussed the alpha-beta pruning algorithm as applied to searching a look-ahead tree for the best strategy in a two-player game. He included a BASIC demonstration game of the alpha-beta procedure called Treasure Search. In this game, the user plays against the computer on an 8 by 8 grid that has a digit between 1 and 9 randomly assigned to each of the 64 grid locations. Players take turns moving from one spot to another, adding the value of each location they land on to their scores. Once a location has been occupied, its value is reduced to 0. Each player attempts to follow a path that leads to the highest numbers; the first player to reach 100 points wins.

Listings 1 and 2 are an improved version of this game for a Radio Shack TRS-80 Model I. The highly efficient alpha-beta tree search has been rewritten in Z80 assembly language, and it now runs about 300 times faster than the original BASIC program. My version has also been enhanced through the use of the *killer heuristic* that was described in Mr Frey's article. Effective moves stored by the regular tree-search routine are recalled by the killer heuristic when the current situation is recognized as being similar to one previously encountered in the course of a game.

This improved program plays a good game at levels five, six, and seven; at levels eight, nine, and ten it should be excellent. Note that even with the reduced computing time of the new version, level ten requires about forty minutes per move. By contrast, a move by the computer at level five in the original version required fifteen minutes; the same level on the improved version takes less than ten seconds.

As given, the program in listing 2 must be loaded beginning at hexadecimal memory location 6000. Altering the ORG statement prior to assembly will allow you to place the code elsewhere in memory. Line 400 of the BASIC program must also be modified so that it will know the new entry point for the machine code.

In a cassette-based system, after you have put these programs on tape, load the BASIC program of listing 1 with the CLOAD command. Then use the SYSTEM command to load the machine-language program assembled from listing 2. Press BREAK after the second program has been loaded to return to the BASIC editor, then type RUN.■

Listing 1: *BASIC portion of an improved version of the game Treasure Search, described in the November 1980 BYTE. This program runs in conjunction with listing 2. Line 400 contains the code that gives the entry point for the machine-language routines in listing 2.*

```
0 CLS:PRINT@5," * TREASURE SEARCH *  BYTE  MAGAZINE - NOVEMBER, 1980"
5 PRINT:PRINT" TREE SEARCH CONVERTED TO ASSEMBLER BY S.F.GALE  B.SC ASPH(CPSC) IN DECEMBER, 19
80"
10 PRINT:PRINT
15 PRINT" THE OBJECT OF THE GAME IS TO SCORE 100 POINTS BEFORE"
20 PRINT"THE COMPUTER DOES. THE COMPUTER MOVES THE '*' AND YOU"
25 PRINT"MOVE THE 'X' ABOUT AN 8X8 BOARD THAT CONTAINS RANDOM"
30 PRINT"NUMBERS BETWEEN 1 AND 9.  WHEN A SQUARE HAS BEEN"
35 PRINT"VISITED, THE VALUE ON THE SQUARE IS THEN ZERO.  MOVES"
40 PRINT"ARE MADE BY PRESSING ONE OF THE FOUR ARROW KEYS."
45 PRINT:PRINT:INPUT"PRESS <ENTER> TO CONTINUE";A$
50 CLS:PRINT" THE PROGRAM USES THE ALPHA-BETA TREE SEARCH"
55 PRINT"ENHANCED BY THE KILLER HEURISTIC.
60 PRINT:PRINT"  MOVE TIMES ARE ROUGHLY AS FOLLOWS:"
65 PRINT"    LEVELS 1 TO 6 - UNDER 10 SECONDS,
70 PRINT"    LEVEL 7       - UNDER 60 SECONDS,
73 PRINT"    LEVEL 8       - UNDER  2 MINUTES,
```

```
75 PRINT"    LEVEL 9        - UNDER 10 MINUTES,
80 PRINT"    LEVEL 10       - ABOUT 40 MINUTES.
85 PRINT:PRINT" THESE TIMES COMPARE FAVORABLY TO BASIC WHERE":PRINT"LEVEL 5 TAKES ABOUT 15 M
INUTES."
95 PRINT:PRINT:INPUT"PRESS <ENTER> TO CONTINUE";A$
100 CLEAR100:CLS:DEFINTA-Z:RANDOM:SH=0:ST=0:Z$=STRING$(32," ")
110 PRINT@463,"PLEASE ENTER YOUR NAME";:INPUTN$
120 DIMA(8),B(99),D(4),E(12),M(12)
130 DIMPV(12,12),Q(12),V(12),Z(12)
140 D(1)=-10:D(2)=-1:D(3)=1:D(4)=10
150 A(1)=10:A(2)=-10:A(4)=-1:A(8)=1:CLS
160 PRINT@461,"COMPUTER PLAYING STRENGTH (1 TO 10) :";:INPUTY
170 DM=2*Y:FORI=11TO88:B(I)=RND(9):NEXTI
180 FORI=0TO10:B(I)=99:NEXTI:FORI=89TO99:B(I)=99:NEXTI
190 FORI=19TO79STEP10:B(I)=99:B(I+1)=99:NEXTI
195 CLS:PRINT@463,"DO YOU WANT TO GO FIRST";:INPUTA$
220 CLS:FORI=11TO88:IFB(I)=99THEN240
230 X$=RIGHT$(STR$(B(I)),I):GOSUB1000
240 NEXTI:PRINT@22,"TREASURE SEARCH";Y
250 PRINT@256,N$;:PRINT@448,"TRS-80";:Y$=STRING$(12," ")
260 T=54:T$=" *":H=45:H$=" X"
270 I=T:X$=T$:GOSUB1000:B(T)=99:B(H)=99
280 I=H:X$=H$:GOSUB1000
285 IFA$="YES"THEN300ELSE400
290 PRINT@788,"ILLEGAL MOVE, TRY AGAIN";:FORI=1TO999:NEXTI
300 PRINT@788,Z$;:PRINT@788,"WHICH DIRECTION FOR X";
310 IFINKEY$=""THEN310ELSER=PEEK(16444)
320 R=INT(R/8):J=H+A(R)
330 IFB(J)=99THEN290ELSEPRINT@788,Z$
360 I=H:B(I)=0:X$=" 0":GOSUB1000:SH=SH+B(J)
370 H=J:B(H)=99:I=H:X$=H$:GOSUB1000
380 PRINT@321,SH;:IFSH>99THEN930
400 POKE16526,0:POKE16527,96
410 FORI=0TO99:POKE32261+I,B(I):NEXTI
420 POKE32258,DM:POKE32259,T:POKE32260,H
430 BM=USR(N)
800 I=T:B(I)=0:X$=" 0":GOSUB1000:PRINT@179,Y$;
810 T=BM:ST=ST+B(T):B(T)=99:I=T:X$=T$
820 GOSUB1000:PRINT@513,ST;:IFST<100THEN300
910 PRINT@915,"THANK YOU FOR A PLEASANT GAME";
920 GOTO920
930 PRINT@917,"CONGRATULATIONS,  YOU WIN";:GOTO920
1000 R=INT(I/10):C=I-10*R:K=141+(8-R)*64+C*4
1010 PRINT@K,X$;:RETURN
```

Listing 2: *The more time-consuming portions of the game have been coded in Z80 assembly language, improving the program speed 300 times. This section of the game must be loaded into otherwise unused memory before you attempt to run the program in listing 1.*

```
                ORG     6000H
        BRD     EQU     7E05H
        MXDPTH  EQU     7E02H
        TRS80   EQU     7E03H
        HUMAN   EQU     7E04H
        FROM    EQU     -12
        TO      EQU     +00
        DCOUNT  EQU     +01
        ALPHA   EQU     -04
        BETA    EQU     +02
        MAX     EQU     +08
        SAVSQR  EQU     +03
        SAVSCR  EQU     +04
        KILLER  EQU     +05
```

Listing 2 continued on page 410

Listing 2 continued:

```
;
;* * * SET UP TREE SEARCH PARAMETERS.
        LD      A,(MXDPTH)      ;SET SEARCH
        LD      (MAXLVL),A      ;  MAXIMUM DEPTH.
        LD      A,1             ;SET THE PLY
        LD      (PLYLVL),A      ;  LEVEL COUNTER.
        LD      A,-1
        LD      (SIDE),A        ;SET SIDE-TO-MOVE.
        LD      A,0             ;ZERO CUMULATIVE
        LD      (SCORE),A       ;  SCORE COUNTER.
        LD      IX,TREE+6       ;START OF TREE DATA.
        LD      (IX+ALPHA),-99
        LD      (IX+BETA),-99
        LD      A,(TRS80)       ;SET LOCATION OF
        LD      (IX-06),A       ;  COMPUTER'S PIECE.
        LD      A,(HUMAN)       ;SET LOCATION OF
        LD      (IX+00),A       ;  HUMAN'S PIECE.
;
;* * * MOVE DOWN ONE PLY LEVEL IN TREE.
NXTLVL  LD      HL,PLYLVL       ;INCREMENT THE
        INC     (HL)            ;  PLY LEVEL COUNTER.
        LD      DE,6            ;MOVE TREE POINTER
        ADD     IX,DE           ;  FORWARD TO NEXT PLY.
        LD      (IX+DCOUNT),5   ;SET THE MOVE COUNTER.
        LD      A,(SIDE)        ;CHANGE  THE
        NEG                     ;  SIDE-TO-MOVE
        LD      (SIDE),A        ;  INDICATOR.
        LD      A,(IX-10)       ;SET NEXT ALPHA,
        LD      (IX+BETA),A     ;  BETA VALUE.
;
;* * * CHECK IF THE KILLER MOVE IS LEGAL.
        LD      HL,DIR          ;DIRECTION TABLE.
        LD      B,4
NXTDIR  LD      A,(HL)          ;GET NEXT MOVE DIRECTION.
        ADD     A,(IX+FROM)     ;CALCULATE NEW SQUARE.
        CP      (IX+KILLER)     ;CHECK IF THIS SQUARE IS
        JP      Z,TRYKIL        ;  THE KILLER MOVE.
        INC     HL
        DJNZ    NXTDIR
;
;* * * CHECK A MOVE AT THIS PLY LEVEL.
NXTMOV  DEC     (IX+DCOUNT)     ;UPDATE MOVE COUNTER.
        JP      Z,PRELVL        ;IF DONE GOTO PLY-1.
        LD      HL,DIR-1        ;DIRECTION TABLE.
        LD      C,(IX+DCOUNT)
        LD      B,0
        ADD     HL,BC
        LD      A,(HL)          ;RETRIEVE DIRECTION.
        ADD     A,(IX+FROM)     ;CALCULATE NEW SQUARE.
;
;* * * CHECK IF MOVE IS KILLER (WHICH HAS BEEN DONE).
        CP      (IX+KILLER)
        JP      Z,NXTMOV
;
;* * * CHECK IF THE MOVE IS LEGAL.
TRYKIL  LD      (IX+TO),A       ;SAVE NEW SQUARE.
        LD      HL,BRD          ;BOARD TABLE.
        LD      C,A
        LD      B,0
        ADD     HL,BC
        LD      A,(HL)          ;RETRIEVE PIECE.
        CP      99              ;CHECK IF LEGAL MOVE.
        JP      Z,NXTMOV        ;IGNOR IF ILLEGAL.
```

```
        LD      (IX+SAVSQR),A   ;SAVE VALUE OF SQUARE.
;
;* * * 'MAKE' MOVE ON BOARD.
        LD      (HL),99         ;MARK NEW SQR ILLEGAL.
        LD      HL,BRD          ;HL=BOARD ADDRESS.
        LD      C,(IX+FROM)     ;RETRIEVE FROM SQR.
        ADD     HL,BC           ;CALCULATE SQR.
        LD      (HL),0          ;MARK SQR LEGAL.
;
;* * * UPDATE THE CUMULATIVE SCORE.
        LD      A,(SIDE)        ;RETRIEVE SIDE-TO-MOVE
        OR      A               ;  AND SET FLAGS
        LD      A,(IX+SAVSQR)   ;GET VALUE OF SQR.
        JP      P,SKIP02        ;BRANCH IF SIDE POSITIVE.
        NEG
SKIP02  LD      (IX+SAVSCR),A   ;SAVE SIDE*SAVSQR.
        LD      HL,SCORE        ;ADDR OF CUMULATIVE SCORE
        ADD     A,(HL)          ;UPDATE SCORE
        LD      (HL),A          ;  AND RESTORE.
;
;* * * CHECK IF SEARCHED TO MAXIMUM DEPTH.
        LD      HL,MAXLVL
        LD      A,(PLYLVL)
        CP      (HL)
        JP      C,NXTLVL        ;BRANCH IF NOT AT MAX.
;
;* * * SET SCORE ON THIS TERMINAL NODE.
        LD      A,(SIDE)        ;RETRIEVE SIDE-TO-MOVE,
        OR      A               ;  SET THE FLAGS,
        LD      A,(SCORE)       ;GET CUMULATIVE SCORE.
        JP      M,SKIP04        ;BRANCH IF SIDE NEGATIVE.
        NEG
SKIP04  LD      (IX+MAX),A      ;SET SCORE ON THIS NODE.
;
;* * * TAKE BACK THE MOVE.
TAKBAK  LD      A,(SCORE)       ;GET CUMULATIVE  SCORE.
        SUB     (IX+SAVSCR)     ;UPDATE THE SCORE
        LD      (SCORE),A       ;  AND RESTORE IT.
        LD      HL,BRD
        LD      C,(IX+TO)
        LD      B,0
        ADD     HL,BC           ;HL=TO SQR.
        LD      A,(IX+SAVSQR)
        LD      (HL),A          ;RESTORE BRD.
        LD      HL,BRD          ;HL=BRD ADDRESS.
        LD      C,(IX+FROM)
        ADD     HL,BC
        LD      (HL),99         ;RESTORE BRD AT FROM.
;
;* * * CHECK IF BEST SCORE AT THIS NODE.
        LD      A,(IX+MAX)
        NEG
        LD      B,(IX+BETA)
        CALL    CMPARE
        CP      1
        JP      NZ,NXTMOV
        LD      A,(IX+MAX)
        NEG
        LD      (IX+BETA),A
;
;* * * STORE BEST MOVE AT LOWEST PLY.
        LD      A,(PLYLVL)      ;CHECK IF AT
        CP      2               ;  LOWEST PLY LEVEL.
```

Listing 2 continued on page 412

Listing 2 continued:

```
        JP      NZ,SAVKIL       ;BRANCH IF NOT.
        LD      A,(IX+TO)       ; OTHERWISE UPDATE
        LD      (BESTMV),A      ; THE BEST MOVE.
        JP      PRUNE
;
;* * * STORE THE NEW KILLER MOVE.
SAVKIL  LD      A,(IX+TO)
        LD      (IX+KILLER),A
;
;* * * PERFORM ALPHA-BETA PRUNING.
PRUNE   LD      A,(IX+ALPHA)
        NEG
        LD      B,(IX+BETA)
        CALL    CMPARE
        CP      1
        JP      Z,NXTMOV
;
;* * * MOVE BACK IN TREE TO PREVIOUS LEVEL.
PRELVL  LD      A,(SIDE)        ;CHANGE THE
        NEG                     ; SIDE-TO-MOVE
        LD      (SIDE),A        ; INDICATOR.
        LD      DE,-6           ;MOVE TREE POINTER
        ADD     IX,DE           ; BACK ONE PLY LEVEL.
        LD      HL,PLYLVL       ;DECREMENT THE
        DEC     (HL)            ; PLY LEVEL COUNTER.
        LD      A,1             ;CHECK IF DONE
        CP      (HL)            ; LAST PLY.
        JP      C,TAKBAK        ;BRANCH IF NOT.
;
;* * * SET HL FOR THE RETURN TO BASIC.
        LD      A,(BESTMV)
        LD      L,A
        LD      H,0
        JP      0A9AH
;
;* * * THIS SUBROUTINE COMPARES TWO 8-BIT SIGNED
;       OPERANDS IN A AND B.
CMPARE  CP      B
        JP      NZ,NOTEQL
        LD      A,0
        RET
NOTEQL  PUSH    AF
        XOR     B
        RLA
        JP      C,DIFFER
        POP     AF
        JP      C,LESST
GREATR  LD      A,1
        RET
DIFFER  POP     AF
        JP      C,GREATR
LESST   LD      A,-1
        RET
MAXLVL  DEFS    1
PLYLVL  DEFS    1
SCORE   DEFS    1
BESTMV  DEFS    1
SIDE    DEFS    1
DIR     DEFB    -10
        DEFB    -1
        DEFB    +1
        DEFB    +10
TREE    DEFS    250
        END
```

System Notes

AIM-65 16-Bit Hexadecimal to Decimal Conversion

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In the early stages of programming our AIM-65 microcomputer, we could not find a 16-bit binary to decimal number conversion subroutine so we developed the subroutine shown in listing 1. The subroutine is entered with the 16-bit number to be converted stored at hexadecimal memory locations 5E (MSB) and 5F (LSB). The results are stored in locations 75 (MSB) to 79 (LSB). The decimal digits are stored with one digit per location. Therefore, if conversion to ASCII is also required, it becomes a simple matter of adding 30 to each digit at the end of the subroutine. Note that the values 10 E8 etc, shown at the end of the listing, must be stored starting at location 780 etc; they are the conversion constants.

Care must be taken if it is necessary to relocate this subroutine since there are several position-dependent instructions.■

Listing 1: *A subroutine for the AIM-65 microcomputer which converts 16-bit binary numbers to decimal values.*

```
  K>*=700
 /50
  0700 A9 LDA #00
  0702 85 STA 75
  0704 85 STA 76
  0706 85 STA 77
  0708 85 STA 78
  070A 85 STA 79
  070C A9 LDA #75
  070E 8D STA 0731
  0711 A9 LDA #80
  0713 8D STA 071F
  0716 A9 LDA #84
  0718 8D STA 0726
  071B 38 SEC
  071C A5 LDA 5E
  071E ED SBC 0785
  0721 85 STA 79
  0723 A5 LDA 5F
  0725 ED SBC 0789
  0728 90 BCC 0735
  072A 85 STA 5F
  072C A5 LDA 79
  072E 85 STA 5E
  0730 E6 INC 7A
  0732 4C JMP 071B
  0735 EE INC 071F
  0738 EE INC 0726
  073B EE INC 0731
  073E AD LDA 0731
  0741 C9 CMP #7A
  0743 F0 BEQ 0748
  0745 4C JMP 071B
  0748 A5 LDA 5E
  074A 85 STA 79
  074C EA NOP
  074D EA NOP
  074E EA NOP
  074F EA NOP
  0750 A0 LDY #00
  0752 A9 LDA #5C
  0754 8D STA 075A
  0757 B1 LDA (88),Y
  0759 4C JMP 076C
  075C D0 BNE 0765
  075E A9 LDA #20
  0760 91 STA (88),Y
  0762 4C JMP 0771
  0765 A9 LDA #6C
  0767 8D STA 075A
  076A B1 LDA (88),Y
  076C 18 CLC

<

  K>*=76D
 /09
  076D 69 ADC #30
  076F 91 STA (88),Y
  0771 C8 INY
  0772 98 TYA
  0773 C9 CMP #06
  0775 D0 BNE 0757
  0777 EA NOP
  0778 EA NOP
  0779 60 RTS

<

  M>=0780 10 E8 64 0A
< > 0784 27 03 00 00
<
```

Fast Line-Drawing Technique

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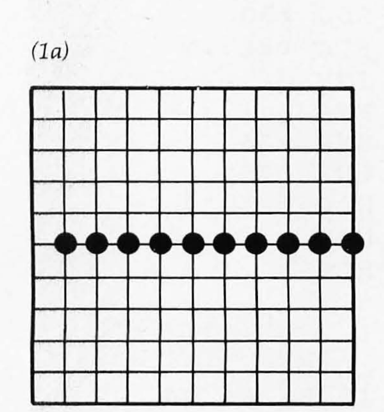
Almost everyone who has a home computer would like to take full advantage of its graphics capabilities, whether this is high-resolution graphics, an addressable cursor capability, or a printer or plotter capable of drawing lines.

Line drawing is the most basic of graphics functions, and in recent years, countless schemes have been put forth in an attempt to devise the best method of performing it. You've been advised to use the point-slope formula to draw lines, but this technique demands lots of floating-point arithmetic and does not draw solid lines when the slope of a line is greater than 1.0 or less than −1.0. One article I read suggested a problem reduction method, where the line segment to be drawn is repeatedly chopped in half until you have two adjacent points. This technique used only integer arithmetic, but it did a lot of redundant calculation. Home-computer owners have devoted an incredible amount of time and effort to coming up with new and creative ways to draw lines, when a simple, efficient algorithm has been available for at least a decade.

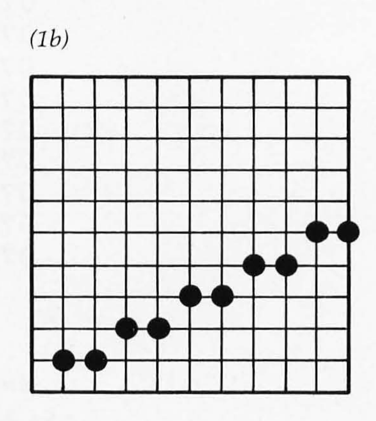
The technique I use is called the DDA, for Digital Differential Analyzer. I first learned about it from Newman and Sproull's book *Principles of Interactive Computer Graphics* (New York: McGraw-Hill, first edition, 1973; second edition 1979). The book was first printed in 1973, so DDA has been around for quite some time. DDA is a technique for producing discrete approximations to the solution of any differential equation, and calculating the values of the coordinates on a line is just one of its uses. DDA produces simple equations that make a lot of intuitive sense. Here's how DDA works: imagine that all the lines you wish to draw are always at angles between 0 and 45° (slope between 0 and 1) and are always drawn left to right, bottom to top.

In figure 1, the number of dots in each line is always equal to the length of the line along the x axis. This is the number of times you will have to perform a loop to generate all the dots in your line. According to the DDA, you should perform the equations inside this loop as shown in listing 1. X0 and Y0 are the coordinates of the starting point, and DX and DY are the lengths of the line along the x and y axes respectively. Incidentally, *DY/DX* is the slope of the line. Each time through the loop, X0 and Y0 are incremented until they are equal to the endpoint of the line, when the loop is finished. Notice that X0 is always incremented by 1, but Y0 is incremented by a floating-point value between 0 and 1. Presumably, the plotting device or graphics hardware on a computer can only plot to integer positions, so Y0 must be truncated or rounded off before it is used.

(1a)



(1b)



(1c)

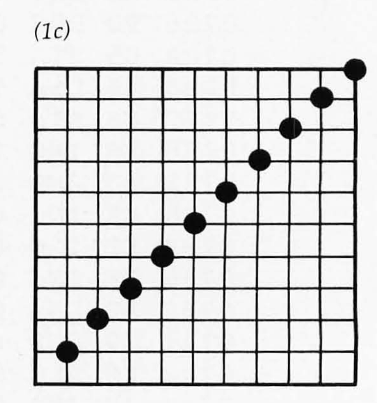


Figure 1: *Examples of simple lines represented by individual coordinate points.*

Newman and Sproull's most sophisticated algorithm separated all the integer operations from the floating-point ones. (See listing 2a.) In the first line of this routine, the remainder value, R, is initialized to ½, so that all results that follow will be rounded off automatically. The slope is calculated outside the loop, so the only floating arithmetic that must be done is addition and subtraction. The integer variable Y0 is incremented by 1 every time R climbs back to a value of 1 or more. After all this work, however, the algorithm still uses floating-point arithmetic, so one further step is required.

I took this algorithm and multiplied all the floating-point equations by DX to come up with a different procedure. (See listing 2b.) Note that the slope calculation can now be eliminated, because the slope, DY/DX, multiplied by DX is equal to DY. Now all the equations in the procedure can be done quickly with integers. The division where R is initialized to DX/2 is the only operation that might take more time; being outside the loop, it is done only once.

This procedure can be adapted to assembly language, where a divide by 2 is a right-shift instruction. In fact, I have written this procedure in Z80 assembly language in which all the variables were stored in the processor registers. That routine can flash a line onto the screen in between video refreshes, and allows some highly interactive programs to be written when called from BASIC.

Even this algorithm, however, has the restrictions mentioned earlier; ie: it only works on lines that have slopes between 0 and 1, and can only draw from left to right, bottom to top. To solve several of these problems, I changed the procedure so that variables are added to X0 and Y0 rather than a constant +1. (See listing 3.) These variables are initialized to 1, but are changed to −1 if the line goes right to left or top to bottom.

The algorithm still needs a way to cope with slopes that have absolute values greater than 1. My solution in those cases is to transpose the axes. That's not as complicated as it sounds, because it means I pretend that the x axis is the y axis and vice versa. When you do that, the slope of the resulting line is always the reciprocal of what it was before, and values greater than 1 become less than 1. To see how this is done, refer to the sample program in listing 4 on page 416.

The subroutine in listing 4 is very flexible. Instead of performing the loop with FOR . . . NEXT statements, it returns each point one at a time to the calling program. I use this routine to plot on a Qume printer/plotter, to move a spaceship or a torpedo on a graphics display grid, and even to draw lines. Each of these applications does something different with the x-y coordinate pairs that the routine returns, but the same routine is used in all of them. The routine returns coordinates and lets the individual main program decide what to do with each pair. Your programs would, perhaps, run faster if you optimized the subroutine for the individual program you use it in. I prefer using modular programming methods, where a routine like this one can be used in several different programs without change.

When I originally wrote the subroutine in listing 4, I used multiple-statement lines, making it much smaller. I also used more descriptive variable names like DX, AX, SX, etc. The routine has been rewritten in elementary BASIC to make it more transportable. Have fun, and good luck!■

Listing 1: *In the simplest form of the DDA algorithm, DX is the difference of the x coordinates of the starting and end points of a simple line; DY is the difference of the y coordinates. The coordinates of the starting point, X0 and Y0, are incremented until they are equal to the coordinates of the end point.*

```
FOR I = 1 TO DX
      XØ=XØ+1
      YØ=YØ+(DY/DX)
NEXT I
```

Listing 2: *Improved line-drawing algorithms. Listing 2a, which is more easily adapted for graphics hardware, produces only integer values for Y0. Listing 2b is the same procedure with the floating-point calculations completely eliminated.*

(2a)

```
R=Ø.5
SLOPE=DY/DX
FOR I = 1 TO DX
      XØ=XØ+1
      R=R+SLOPE
      IF R >= 1.Ø THEN YØ=YØ+1 :  R=R-1.Ø
      PLOT XØ,YØ
NEXT I
```

(2b)

```
R=DX/2
SLOPE=DY
FOR I = 1 TO DX
      XØ=XØ+1
      R=R+SLOPE
      IF R >= DX THEN YØ=YØ+1 :  R=R-DX
      PLOT XØ,YØ
NEXT I
```

Listing 3: *Revision of listing 2 which will draw lines from right to left and top to bottom as well as vice versa.*

```
R=DX/2
AX=1
SY=1
IF DX < Ø THEN DX=ABS(DX) :  AX=-1
IF DY < Ø THEN DY=ABS(DY) :  SY=-1
FOR I = 1 TO DX
      XØ=XØ+AX
      R=R+DY
      IF R >= DX THEN YØ=YØ+SX :  R=R-DX
      PLOT XØ,YØ
NEXT I
```

Listing 4: *Sample BASIC program that returns the x and y coordinate points between given starting and end points. Lines of any slope between −1 and 1 can be calculated with this version of the DDA algorithm.*

```
10 REM ***********************************************
20 REM PROGRAM TO DEMONSTRATE THE LINE SUBROUTINE
30 REM ***********************************************
40 PRINT "WHAT IS THE FIRST POINT";
50 INPUT XØ,YØ
60 PRINT "WHAT IS THE SECOND POINT";
70 INPUT X1,Y1
80 GOSUB 6000
90 PRINT XØ,YØ
100 IF N1>D1 THEN STOP
110 GOSUB 6300
115 PRINT XØ,YØ
120 GO TO 100
5974 REM**********************************
5975 REM LINE DRAWING ROUTINE.  THIS ROUTINE RETURNS
5976 REM ALL THE X,Y CO-ORDINATE POINTS BETWEEN
5977 REM TWO POINTS.  THE STARTING AND ENDING CO-ORDINATES MUST
5978 REM BE SENT IN THE VARIABLES XØ,YØ AND X1,Y1.  TO INITIATE
5979 REM A LINE, YOU MUST GOSUB 6000.  TO GET EACH SUCCESSIVE POINT,
5980 REM YOU GOSUB 6300, AND THE NEXT POINT IS RETURNED IN XØ,YØ.
5981 REM TO TELL WHEN THE LINE IS FINISHED, YOU
5982 REM MUST CHECK THE VARIABLE N1, IF N1<=D1 THEN THERE ARE
5983 REM STILL MORE POINTS TO GO.
5984 REM
5985 REM VARIABLES USED:
5986 REM    XØ,YØ,X1,Y1 - PARAMETERS SENT TO THE LINE ROUTINE
5987 REM    XØ,YØ,N1,D1 - RETURN VALUES AND STATUS
5988 REM    D2,D3,S1,S2,A1,A2 - INTERNAL SCRATCH VARIABLES.
5989 REM NONE OF THESE VARIABLES SHOULD BE USED IN YOUR MAIN PROGRAM
5990 REM **********************************************************
6000 D1=X1-XØ
6010 D2=Y1-YØ
6020 S1=Ø
6030 S2=1
6040 A1=1
6050 A2=Ø
6060 IF D1>=Ø GO TO 6090
6070 A1=-1
6080 D1=-D1
6090 IF D2>=Ø GO TO 6120
6100 D2=-D2
6110 S2=-1
6120 IF D1>=D2 GO TO 6200
6130 N1=D1
6140 D1=D2
6150 D2=N1
6160 S1=A1
6170 A1=Ø
6180 A2=S2
6190 S2=Ø
6200 D3=D1/2
6210 N1=1
6220 RETURN
6230 REM *******************************************************
6240 REM HERE IS WHERE THE DDA (DIGITAL DIFFERENTIAL ANALYZER)
6250 REM ALGORITHM IS ACTUALLY PERFORMED.  EACH GOSUB TO THE ROUTINE
6260 REM INCREMENTS XØ,YØ BY THE CORRECT AMOUNT.  WHEN N1>D1 THE LAST
6270 REM POINT HAS ALREADY BEEN RETURNED, AND SUCCESSIVE CALLS WILL
6280 REM EXTRAPOLATE XØ,YØ PAST THE END POINT OF THE LINE.
6290 REM **********************************************************
6300 XØ=XØ+A1
6310 YØ=YØ+A2
6320 D3=D3+D2
6330 N1=N1+1
6340 IF D3<=D1 THEN RETURN
6350 D3=D3-D1
6360 XØ=XØ+S1
6370 YØ=YØ+S2
6380 RETURN
```

Word Ujbnmurle

Leonard Gorney, Box 91 RD 5, Clarks Summit PA 18411

Here is a short routine I use on my Radio Shack TRS-80 Model I Level II when I try to solve scrambled word puzzles in a "friendly" game of Scrabble, or the like.

The program accepts the letters you wish to form into an acceptable English word, rearranges the letters in a random fashion, and prints each rearrangement for viewing. This method parallels the situation in which a monkey is given a typewriter. How long will it take the monkey, typing at random, to type an English word? The program plays the part of the monkey.

The user of this short routine must look at each of these rearrangements to see if a valid English word is printed. At times, a valid English word will magically appear on the screen; however, the human eye and brain can, in more cases than not, discern a particularly scrambled string of letters as an English word. This will often be the case, even though many of the letters are not in their proper positions within the word.

As an example of this, look again at the second word of the title of this article. Can you discern what English word is represented by that string of letters? How about this string of letters: ENLIGSH ?

Listing 1: *This routine in Radio Shack TRS-80 Level II BASIC accepts a string of up to 30 letters and displays them in a randomly rearranged form. Ideally, the user will be able to discern the English word in the jumbled letters.*

```
1000 REM   WORD UNJUMBLER
           LEN GORNEY
1010 DIM A$(30), B(30)
1020 REM   FORCE 32 CHARACTERS/LINE MODE
1030 CLS: PRINT CHR$(23)
1040 PRINT TAB(7);"ENTER YOUR LETTERS": INPUT W$
1050 REM FILL EACH A$ LOCATION WITH ONE LETTER
     FROM W$
1060 FOR J = 1 TO LEN(W$): A$(J) = MID$(W$,J,1):
     NEXT J
1070 REM A LOCATION IN B WILL BE ZERO IF LETTER NOT
         USED YET OR A -1 IF LETTER USED BEFORE
1080 FOR J = 1 TO LEN(W$): B(J) = 0: NEXT J
1090 CLS: PRINT CHR$(23)
1100 REM GENERATE A RANDOM NUMBER IN THE RANGE 1
         TO LEN(W$) USE THIS NUMBER TO PICK A LETTER
         FROM A$
1110 N = RND(LEN(W$))
1120 IF B(N) = 0 THEN PRINT A$(N);: B(N) = 1
1130 REM HAVE ALL THE INPUT LETTERS BEEN
     REARRANGED ?
1140 FOR J = 1 TO LEN(W$): IF B(J) = 0 THEN 1110
1150 NEXT J
1160 REM STALL THE REARRANGED WORD FOR VIEWING
1170 FOR J = 1 TO 1000
1180 NEXT J
1190 GOTO 1080
1200 END
```

Permutations

Mathematically, rearranging a given set of letters involves the application of permutations. For example, given the letters GELNSIH, the number of different ways in which those 7 letters can be rearranged to give different rearranged strings is equal to 7 ! (read 7 factorial) or $7 \times 6 \times 5 \times 4 \times 3 \times 2 \times 1$ which is equal to 5040 different rearrangements. This program does not use this idea; rather, the input set of letters is rearranged randomly. Usually, a certain rearrangement of the input string will be sufficient for the user to "see" the English word in that set of letters. This assumes that an acceptable English word can be spelled by using those input letters. Otherwise, you will continue to see gibberish on your screen.

Program Operation

Running the program is rather easy; the only external entry you need to make is to enter the letters you wish to unscramble. Just press each letter key, and when you are finished with the string, press the enter key.

Each rearrangement of those input letters will be displayed on the screen in 32-character-per-line mode. The choice of a maximum of 30 characters for the input set of letters was done so that the entire word would fit on a single line of the screen. Each rearrangement will be frozen on the screen for approximately 2 seconds. When you see a particularly suitable rearrangement, press the *break* key to stop the program. Not being a particularly intelligent monkey, the computer will continue printing rearrangements until it powers down, unless stopped in this way. ■

Binary-to-BCD Converter Program for the 8080

D M Brockman, 11648 Military Rd S, Seattle WA 98168

Conversion of multiple-precision binary numbers to BCD (binary-coded decimal) for printing or display output is often encountered in assembly-language programming. The algorithm described here makes use of the 8080's DAA (decimal-adjust accumulator) instruction to implement the BCD analogy of a binary shift-left register. With this algorithm, a binary number is converted to packed BCD (2 digits per byte) by shifting the binary number, MSB (most significant bit) first, bit by bit, into the least significant end of the BCD register. (See figure 1.) When the last binary bit has been shifted in, the result is in the BCD register.

To understand how the BCD register operates, consider a conventional binary-shift register. When shifted left, the numeric content doubles and the carry input (if any) comes in at the least significant end. The same thing happens when the BCD register is "shifted." The numeric doubling is accomplished by adding the BCD register to itself using BCD arithmetic. The carry is brought in by using the ADC (add with carry) instruction for the first "add."

A typical implementation of the algorithm is shown in listing 1 in the form of an 8080 assembly-language listing. Looping constructs have been employed to minimize size. For maximum speed, the loops should be "unrolled." The implementation converts a 32-bit (4-byte) binary number into a 10-digit (5-byte) packed BCD result. The number of bytes converted can be easily changed by altering the looping counters. Note that the number of BCD result bytes required is given by:

Number of BCD bytes = INT(0.5 + 1.204 × (Number of binary bytes))

An advantage of this algorithm is that the conversion time is independent of the size of the number being converted. The sample routine in listing 1 requires 13,944 machine cycles to execute. The results of a typical run of the sample routine are shown in table 1. ■

Figure 1: *Contents of the BCD and binary registers during the conversion process using the program shown in listing 1.*

Memory Address	Before Run	After Run
BIN:		
0200	3A	00
0201	F6	00
0202	23	00
0203	81	00
BCD:		
0204	XX	58
0205	XX	76
0206	XX	61
0207	XX	66
0208	XX	21

Table 1: *A sample run of the binary-to-BCD converter program shown in listing 1. All numbers shown are hexadecimal. XX indicates a don't care.*

Listing 1: *A binary-to-BCD converter program for the Intel 8080 microprocessor.*

```
                ;TITLE "BINARY TO BCD CONVERTER"
                ;BY D. M. BROCKMAN, 11648 MILITARY RD. SO., SEATTLE, WA 98168
                ;
                ;THIS SUBROUTINE CONVERTS THE 32-BIT BINARY NUMBER STORED
                ;  AT 'BIN' TO A 10-DIGIT PACKED BCD NUMBER STORED AT 'BCD.'
                ;  REGISTERS B, C, H, L, AND A ARE USED.
                ;
                ;
                ;DEFINE STORAGE FOR NUMBERS:
                ;
0200                    ORG 200H
0200            BIN:    DS 1            ;LSB BYTE
0201                    DS 2
0203                    DS 1            ;MSB BYTE
                ;
0204            BCD:    DS 1            ;LS DIGITS
0205                    DS 3
0208                    DS 1            ;MS DIGITS
                ;
                ;
                ;INITIALIZE THE BCD RESULT BYTES TO ZERO:
                ;
0100                    ORG 100H
0100 210402     BINBCD: LXI H,BCD       ;POINT AT RESULT
0103 0605               MVI B,5         ;SET LOOP COUNTER
0105 3600       ILOOP:  MVI M,0         ;STORE A ZERO
0107 23                 INX H           ;POINT TO NEXT BYTE
0108 05                 DCR B           ;DECREMENT LOOP COUNTER
0109 C20501             JNZ ILOOP       ;LOOP IF NOT DONE
                ;
                ;INITIALIZE THE BIT COUNTER TO EQUAL THE NUMBER OF
                ;  BINARY BITS TO BE SHIFTED:
                ;
010C 0620               MVI B,32        ;NUMBER OF BITS TO SHIFT
                CLOOP:                  ;THE MAIN LOOP POINT
                ;
                ;INITIALIZE FOR A MULTIPLE PRECISION LEFT SHIFT
                ;  OF THE BINARY NUMBER:
                ;
010E 210002             LXI H,BIN       ;POINT AT NUMBER
0111 0E04               MVI C,4         ;NUMBER OF BYTES
0113 AF                 XRA A           ;CLEAR THE CARRY
                ;
                ;SHIFT THE BINARY NUMBER ONE PLACE LEFT AND LEAVE THE MSB
                ;  IN THE CARRY:
                ;
0114 7E         RLOOP:  MOV A,M         ;GET BYTE
0115 17                 RAL             ;SHIFT LEFT
0116 77                 MOV M,A         ;STORE BYTE
0117 23                 INX H           ;POINT AT NEXT BYTE
0118 0D                 DCR C           ;DECREMENT BYTE COUNT
0119 C21401             JNZ RLOOP       ;LOOP IF NOT DONE
                ;

                ;INITIALIZE TO DOUBLE THE BCD RESULT REGISTER CONTENTS
                ;  BY PERFORMING A MULTIPLE PRECISION BCD ADD:
                ;
011C 210402             LXI H,BCD       ;POINT AT RESULT
011F 0E05               MVI C,5         ;SETUP BYTE COUNTER
                ;
                ;DOUBLE THE RESULT BCD FASHION, ADDING IN THE CARRY BIT:
                ;
0121 7E         BLOOP:  MOV A,M         ;GET BYTE
0122 8E                 ADC M           ;ADD IT TO ITSELF
0123 27                 DAA             ;BCD CONVERT
0124 77                 MOV M,A         ;RESTORE
0125 23                 INX H           ;POINT AT NEXT BYTE
0126 0D                 DCR C           ;DECREMENT BYTE COUNTER
0127 C22101             JNZ BLOOP       ;LOOP IF NOT DONE
                ;
                ;TEST TO SEE IF ALL BITS HAVE BEEN SHIFTED FROM BINARY
                ;  NUMBER TO THE BCD RESULT. IF NOT, RETURN TO MAIN LOOP.
                ;
012A 05                 DCR B           ;DECREMENT BIT COUNTER
012B C20E01             JNZ CLOOP       ;LOOP IF NOT DONE
012E C9                 RET


012F                    END

A>
```

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What's New?

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Graphics for Okidata Printers

The PF/2A print formatter uses the plotting capabiltity of the Okidata SL125 and SL250 printers to create bar codes, variable-size and aspect-ratio characters, product and corporate logos, variable-forms layouts, banners, and signs. The formatter permits normal matrix-character printing as well. The PF/2A has a suggested retail price of $2295. Contact Technical Analysis Corporation, 120 W Wieuca Rd NE, Atlanta GA 30042, (404) 252-1045.

Circle 500 on inquiry card.

Phonetic Speech Kit from Votrax

A sample voice-synthesizer evaluation kit is available from Votrax. The Speech PAC (Phoneme Access Controller) is a circuit board made up of a speech integrated circuit, external controller, memory, and an on-board audio amplifier. The unit comes with 250 words and phrases stored in memory that can be intermixed with phoneme sequences to provide an unlimited vocabulary. Priced at $275, the Speech PAC can be expanded and configured into microcomputer systems.

For complete details, contact Vortrax, 500 Stephenson Hwy, Troy MI 48084, (800) 521-1350; in MIchigan (313) 588-0341.

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Hard Copy for $299

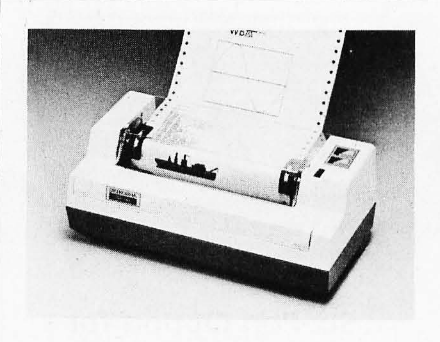
Microtek Inc has announced a $299 dot-matrix printer. The Bytewriter-1 features 80 columns and accepts single-sheet or roll paper up to 8½ inches wide. It prints at 60 lpm (lines per minute) using a 7 by 7 matrix. The interface is similar to Centronics's and has been designed to operate with the Apple II, Atari 400 and 800, and all TRS-80 microcomputers. Contact Microtek Inc, 9514 Chesapeake Dr, San Diego CA 92123, (714) 278-0633.

Circle 502 on inquiry card.

Amtek's Universal Terminal

The ABM 80 video terminal can replace most commercial terminals. It features a 12-inch high-resolution green screen; numeric and special-function keypad; editing, block, and monitor modes; protective and unprotective fields; foreground and background; programmable key click; and margin bell. It includes 7 by 9 dot matrix upppercase and 7 by 11 lowercase. Switch-selectable emulation of Hazeltine 1500, ADDS 25, ADM-3A, and VT-52, with block mode and advanced editing features, is included in this $800 terminal. Contact Amtek Business Machines Inc, 2255H Martin Ave, Santa Clara CA 95050, (408) 727-1510.

Circle 503 on inquiry card.



Single-Hammer Printer

The GP-80M printer uses a single print hammer in a 5 by 7 dot matrix. It can print graphics and alphanumerics. The GP-80M uses a rotating platen with protruding splines positioned behind the paper. The image is created by multiple hammer strikes as the printhead moves across the paper in front of the platen. Features include upper- and lowercase character sets, up to 80 columns with 12 characters per inch, tractor feed, three-copy reproduction, 12 W power consumption, and a Centronics parallel interface. RS-232C and other common interfaces are optional.

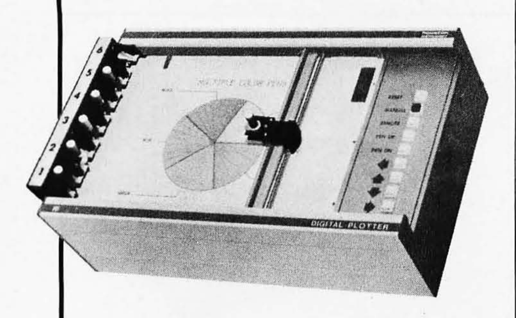
The graphics capability provides more than 60 dots per inch. Dot graphics and alphanumerics can be mixed under software control. Print speed is 30 cps (characters per second). The price is $399 from Axiom, 1014 Griswold Ave, San Fernando CA 91340, (213) 365-9521.

Circle 504 on inquiry card.

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PERIPHERALS



Six-Pen Option for Hi-Plot Plotters

A six-pen plotter option is available for the Houston Instrument DMP plotters. The pens come in black, red, blue, green, violet, orange, and optional brown. They work under program control and can be retrofitted into any of the Hi-Plot plotters. The $395 pen option can be installed by users except on the DMP-5, -6, and -7, which can be connected at the factory for $100. A program for generating graphs and charts, HIgraph-1, is available. For details, contact Houston Instrument, 1 Houston Sq, Austin TX 78753, (512) 837-2820. Circle 505 on inquiry card.

A Clock for the Apple II

Time II is a real-time clock and calendar for the Apple II. It measures time in hours, minutes, and seconds, and provides dates with year, month, date, day of week, and leap-year information. The board features a 24-hour military format or a normal 12-hour format. Time II permits foreground and background operation of two programs simultaneously, so users can call up schedules, time events, and date listings. An onboard backup battery provides more than four months of power-off operation.

Time II is available for $150 from Applied Engineering, POB 470301, Dallas TX 75247, (214) 492-2027.

Circle 506 on inquiry card.

Smartmodem from Hayes

The Smartmodem is an FCC (Federal Communications Commission) approved direct-connect device. It has an RS-232C port and can be program-controlled in any language by ASCII (American Standard Code for Information Interchange) character strings. The modem analyzes and executes commands and can send codes in English words or decimal digits. The Smartmodem has auto-dial and auto-answer capabilities, both of which can be combined within a command.

The Hayes Stack Smartmodem can be connected to any kind of telephone. An audio monitor can alert users to wrong numbers and busy signals. If a busy signal is encountered, the Smartmodem redials the number at any time. Operation can be in full- or half-duplex with a data rate of 0 to 300 bps (bits per second). One command selects the dialing speed, escape-code characters, and number of rings to answer on. The suggested price for the modem is $279, including a power pack, a cable, and a manual. For details, contact Hayes Microcomputer Products Inc, 5835 Peachtree Corners E, Norcross GA 30092, (404) 449-8791. Circle 507 on inquiry card.

Disk Doubler

The Disk Doubler converts a single-sided 5-inch floppy disk into a double-sided floppy disk. Using the kit's tools, you can measure, mark, and punch new openings in the disk's protective sheath. The punch can't damage the disk. The Disk Doubler costs $6.95 and is available from the Beals Agency, 4141 Fairmount Ave, San Diego CA 92105, (714) 284-1145.

Circle 508 on inquiry card.

Speed-Up Board for the TRS-80

Simutek's Micro-Speed board is for the TRS-80 Model I Level II computer. The Micro-Speed increases the microprocessor clock rate to 2.66 MHz, which is almost 50% faster than the standard rate. The unit divides the system-clock signal differently to make the computer operate at this speed. Operation can be switched back and forth between regular and high speeds. The board is not software-dependent. Micro-Speed returns the computer to normal speed during access of the floppy disk or cassette; it returns to high speed upon completion of the I/O (input/output) operation. The only drawback to the device is that the Radio Shack warranty is void after installation of the unit, which requires some soldering.

The board, switch, and wires cost $29.95. Contact Simutek, POB 13687, Tucson AZ 85732.

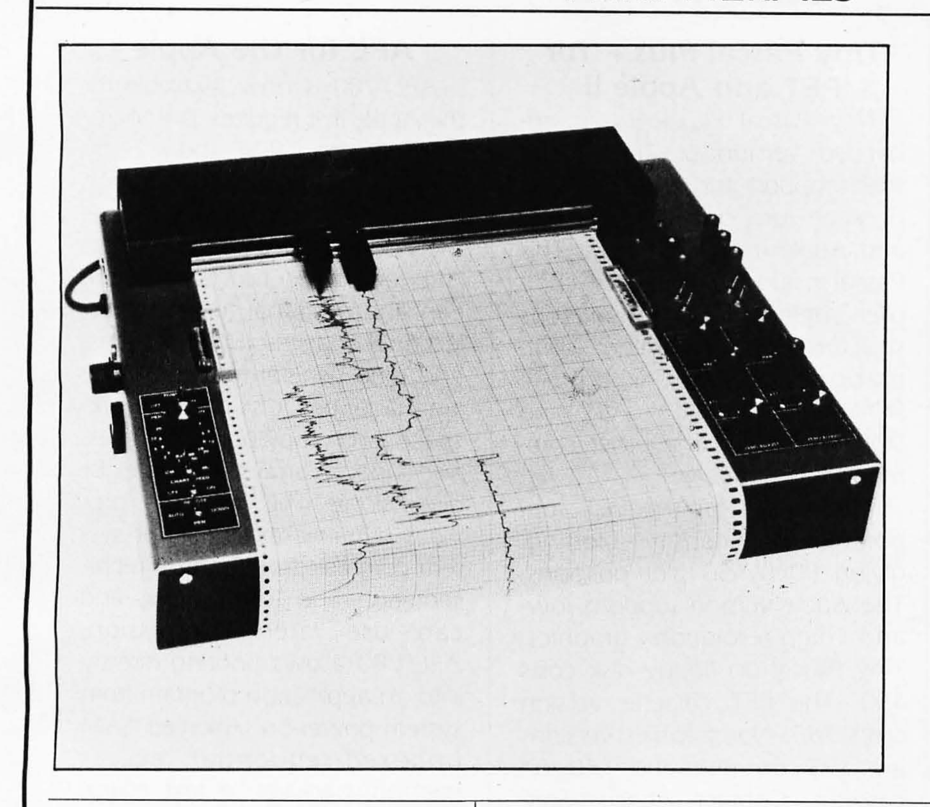
Circle 509 on inquiry card.

Microcomputer Modem

The 103J-L is a 300 bps (bits per second) modem that costs less than $200. It operates over all rotary-telephone lines, even those that cannot be used by line-powered units. Data or talk modes are switch-selectable, and the answer and originate modes are automatic. An indicator shows transmit- and receive-data activity, and a carrier-detect indicator shows a call is established. For installation, the plug from the telephone connects to a jack in the 103J-L's rear panel. A connector from the modem accesses the telephone line.

For complete details, contact General DataComm Industries Inc, 1 Kennedy Ave, Danbury CT 06810, (203) 797-0711.

Circle 510 on inquiry card.



Strip-Chart Recorders

The Series MR English/Metric strip-chart recorders in single- and dual-pen versions provide speeds of 0.05 to 20 inches per minute and per hour and 1 to 50 cm per minute and per hour. Other features of the Series MR include fifteen calibrated input ranges from 1 mV to 50 V, input on/off and positive or negative polarity reversal switches, manual chart rewind/advance, electric and remote pen lift, and automatic shutdown for over-range signals. The single-pen recorder is $810 and the dual-pen is $1180. Contact Pedersen Instruments, 2772 Camino Diablo, Walnut Creek CA 94596, (415) 937-3630.

Circle 511 on inquiry card.

Interface for Analytical Instruments

SmartFact connects to the analog output of any analytical instrument and uses an RS-232C format for transmission. Two instruments can be connected simultaneously. The instrument's output is sampled at 0.1 or 1 second intervals and transmitted at one of six selectable data rates. The analog signals are converted into 16-bit words. X and Y signals from an instrument can be monitored and digitized.

Applications include peak picking in UV or AA quantitative analysis, calculation of retention time in gas or liquid chromatography, preparing peak tables for qualitative infrared comparisons, logging sample weights from an analytical balance, or determining the endpoint of an automatic titration. For information, contact Analytical Computers, POB 285, Elmhurst IL 60126.

Circle 512 on inquiry card.

Super Keyboard

The MFJ Model MFJ-496 keyboard sends CW (continuous wave), baudot, and ASCII (American Standard Code for Information Interchange) with a 256-character buffer, 256-character programmable message memory, four automatic messages, two random-code practice modes, data-rate and buffer metering, backspace delete, buffer-memory hold, automatic serial numbering, repeat/delay, and a paddle input port. One or two keystroke combinations execute all commands. Five-level baudot is transmitted at 60 words per minute. In the ASCII mode, transmission speed is 110 bps (bits per second).

The MFJ-496 operates on 9 to 12 V DC. It costs $339.95 and is available from MFJ Enterprises Inc, POB 494, Mississippi State MS 39762, (800) 647-1800; in Mississippi (601) 323-5869.

Circle 513 on inquiry card.

Voice Synthesis for Heath Computers

The V-8 Voice Synthesizer for Heath H-8 and H-89 computers uses the Votrax VSL Phoneme Module, which, under program control, adds the capability of inflection or range to synthesized speech. Software for the V-8 includes a device driver and several English-speaking programs. The V-8 can be used with any computer having an available parallel port. Eight data and two handshaking lines are required.

The V-8 Voice Synthesizer costs $149, which does not include the VSL module. A sample voice cassette is available for $5.

For additional details, contact M.I.-8, 822 E County Rd 30, Fort Collins CO 80525, (303) 669-4116. Votrax can be contacted at 500 Stephenson Hwy, Troy MI 48084, (800) 521-1350; in Michigan (313) 588-0341.

Circle 514 on inquiry card.

What's New?

SOFTWARE

Ultrasort Gives CP/M Users Fast Sorts

Ultrasort II is an 8080 and Z80 machine-language program that allows CP/M and CBASIC2 users to sort, merge, or select records from data files, or to find the number of logical records in a file. It can be used as a stand-alone utility or as a subroutine called from CBASIC2. Ultrasort II sorts on up to five keys, and fields can have a fixed or a variable length. Strings can optionally be floated as numeric fields; numeric fields are automatically floated. A select capability permits either omitting or including records that are less than, equal to, or greater than up to four independent select keys. Ultrasort II is available from Computer Control Systems Inc, 298 21st Ter SE, Largo FL 33541.

Circle 516 on inquiry card.

Letter Perfect for the Atari

Letter Perfect is a word-processing package for the Atari 800. It features proportional spacing, page numbering, headers, footers, and underlining. Embedded commands in text for expanded, normal, and condensed print are possible. The program is menu-driven. The user can change drive numbers; edit, load, save, merge, print, lock and unlock, and delete files; format disks; and perform a data-base merge for mailings. Printing and screen formats are programmable. Text block moves, scrolling forward and backward, scrolling speed, search, tabbing, and character and line insertion and deletion are among its features. Letter Perfect is available for $150 from LJK Enterprise Inc, POB 10827, St Louis MO 63129, (314) 846-6124.

Circle 517 on inquiry card.

Tiny Pascal Plus+ for PET and Apple II

Tiny Pascal Plus+ is an enhanced version of Tiny Pascal with support for graphics. The package runs on 32 K-byte PET and Apple microcomputers. This Pascal includes a line editor, compiler, interpreter, and numerous structured programming commands. GRAPHICS, PLOT, POINT, TEXT, INKEY, ABS, and SQR are among the other command functions.

Tiny Pascal for the PET supports double-density plotting, giving 80 by 50 plot positions. The Apple version supports low- and high-resolution graphics. Tiny Pascal on floppy disk costs $50. The PET cassette version costs $55. Nongraphics versions are $35 on disk and $40 on cassette. Contact Abacus Software, POB 7211, Grand Rapids MI 49510.

Circle 518 on inquiry card.

Applegraph Your Business Charts

Applegraph is a software package for general-purpose data plotting in a variety of formats for the business, professional, and research decision maker. The program yields high-resolution, multicolor graphics for video display and hard-copy output. Display formats include pie charts, bar graphs, area plots, points, and solid or dashed lines, produced in any combination of overlays. Applegraph has simple commands that can be entered interactively or in advance. Data can be entered directly or supplied from other programs. Applegraph is available for $200 from Business & Professional Software Inc, POB 11, Kendall Square Branch, 238 Main St, Cambridge MA 02142, (617) 491-3377.

Circle 519 on inquiry card.

APL for the Apple

APL/V80 is now available for the Apple II. It requires the Microsoft SoftCard, CP/M, and a 24 by 80 video board. Another version is available that doesn't require the video card. APL/V80 includes APL arithmetic functions, Boolean and relational functions, selectional and structural functions, and nine general functions. The language has disk-based workspace and copy-object libraries, and supports arrays of up to eight dimensions. The software provides dynamic execution of system commands, canonical representation and function fix, and can use latent expression. APL/V80 allows booting directly into an application program from system power-on. A keyed ISAM (indexed-sequential access method) package, a text editor, and a check-management package are available as options for $50 each.

APL/V80 costs $500. It is available from Vanguard Systems Corporation, 6901 Blanco, San Antonio TX 78216, (512) 340-1978.

Circle 520 on inquiry card.

FORTH for SwTPC Computers

FORTH is available for SwTPC computers with Percom disk drives. This FORTH, based on fig-FORTH, comes on a single-density 5-inch floppy disk and requires 16 K bytes of memory and a Percom disk drive with Mini-DOS. The disk contains the object code, a text editor, and assorted utilities. The manual contains a description of FORTH words, a tutorial, an explanation of the screen editor, and more. The package sells for $24.95 from Greene Software, 6169 Fawn Meadow, Victor NY 14564.

Circle 521 on inquiry card.

SOFTWARE

Apple II Graphics System

The 3-D Graphics module is designed for 48 K-byte Apple IIs. It features a drawing module for a high-resolution screen using paddles or a joystick. The 3-D graphics module helps create, view, and manipulate 3-D objects. Color figures can be viewed simultaneously, and each figure can be individually manipulated. An upper- and lowercase character set is provided, along with a set twice as tall and wide. A character editor allows programmers to create and edit large and small fonts. A text module places text anywhere on the screen. Programming instructions are included for using pictures, shape tables, and machine-language subroutines in other programs, along with the file structure for 3-D files.

Typing can be set to overlay, reverse, or erase the background. Editing functions can move points and lines, change colors, and enter, change, and delete coordinates. A shrink utility shrinks pictures to one-quarter to one-sixty-fourth of original size.

Options include a filing routine with more than 100 blended colors, a paintbrush mode that turns the cursor into one of nine different size and shape brushes, and a shape mode that rotates, scales, and plots shapes from a shape table.

The price for this package is $59.95. It requires a 48 K-byte Apple II and Applesoft firmware or the language system. Contact Micro Co-Op, POB 432, West Chicago IL 60185, (312) 231-0912.

Circle 522 on inquiry card.

C for Cromemco Systems

Cromemco has made the C programming language available for use on its microcomputers. C is a general-purpose language that features economy of expression, modern control-flow and data structures, and many operators. C combines the features of assembly languages with the structured-programming techniques available in higher-level languages. It is useful for writing operating systems, language systems, utilities and input/output drivers, communication software, data-base-management systems, file-management software, and fast graphics software.

C operates under Cromemco's Cromix operating system. It produces relocatable code that can be linked with other languages. It is available on 5- and 8-inch floppy disks for $595. For additional information, contact Cromemco Inc, 280 Bernardo Ave, Mountain View CA 94043, (415) 964-7400.

Circle 523 on inquiry card.

Two- and Three-Dimensional Hard-Copy Graphics Programs

Curve is a two-dimensional graphics package that provides users with the capabiltiy to plot Cartesian, parametric, and polar equations as well as data points. Full axes labeling and scaling are provided for linear or logarithmic plotting. Shaded-bar graphs are also included. The program works on Houston Instrument's Hi-Plot plotters and Watanabe plotters. It runs on Apple, TRS-80, PET, and North Star computers.

Another member of the Curve family is Three-D. It can plot surface functions and data or space curves and rotate them a complete 360° with scaled axes and labeling. Hidden lines are optional. The programs cost $199 each. For more information, contact West Coast Consultants, 1775 Lincoln Blvd, Tracy CA 95376, (209) 835-1780.

Circle 524 on inquiry card.

Collection of CP/M Programs

The CP/MUG (CP/M Users Group) has compiled more than 1000 programs for CP/M systems. On 40 floppy disks, these programs are available for a small charge.

CPM/UG.DB is a data base containing references to all the programs on these disks. Each program or collection is referenced by key words. The data base contains references to 22 assemblers and disassemblers, 138 games, 14 versions of Startrek, 35 file-maintenance programs, and 22 languages.

CPM/UG.DB is supplied with Information Master, a data-base program from Island Cybernetics, on single-density 5- or 8-inch disks. The program costs $20, or $15 when ordered with Information Master at $37.50 from Elliam Associates, 24000 Bessemer St, Woodland Hills CA 91367.

Circle 525 on inquiry card.

Data-Base System for Microcomputers

VIM (versatile information manager) is a data-base management system that aids in organizing and retrieving information. VIM can be used in keeping personnel records, inventory, mailing lists, stock transactions, property lists, or it can be used for cataloging items. VIM runs on the TRS-80 Model I and requires a minimum of 32 K bytes of programmable memory, an expansion interface, and one or more disk drives. It also requires a TRSDOS 2.2 or NEWDOS operating system.

The price for the three modules that comprise the entire package is $99.95. Contact Microcosm Inc, POB 2034, Dearborn MI 48123.

Circle 526 on inquiry card.

What's New?

SOFTWARE

Software Tools for Pascal Programmers

The Screen Handler program includes a program to create a file of prompts; a program for adding, changing, deleting, and listing prompts; a test file to include with user programs; and error checking. You can add, change, delete, or display data on a video display. It costs $75.

The Output Formatter has tab functions, automatic page and line counters during program execution, and top-of-form routines. It allows right, left, or center justification of data to be printed and handles printing of strings, integer, and log-integer variables. The Output Formatter costs $37.50.

The Forms Generator includes the Output Formatter and additional software for redesigning reports without programming. The user can choose any number of items from a data list and specify the column and row where they are to be printed. This $49.50 program is useful for insurance claims, checks, invoices, and other forms.

Source code for these programs is available on Apple-compatible or 8-inch floppy disks in UCSD Pascal or Pascal/M. Contact HDP Inc, 222 E Anapamu St, Santa Barbara CA 93101, (805) 965-4477.

Circle 527 on inquiry card.

TRS-80 Spelling Checker

Hexspell is compatible with most of the word-processing programs available for the TRS-80. Hexspell checks words in text files against its 29,000-word vocabulary, while displaying the text for a manual proofreading. Erroneous words are shown and can be immediately replaced. The replacement word is instantly rechecked. A single keystroke teaches Hexspell a new word. Hexspell requires a 48 K-byte TRS-80 Model I with two disk drives. The program is available for $69 from Hexagon Systems, POB 397, Station A, Vancouver, British Columbia, V6C 2N2, Canada, (604) 682-7646.

Circle 528 on inquiry card.

SB/E Version 4 for the SuperBrain

SB/E version 4 is a firmware and software set enhancing CP/M on the Intertec SuperBrain. Disk capacity is increased 16% and the track-to-track step rate is five times faster. With the new version, the spindle motor can be shut off when the disks are not being accessed.

SB/E Version 4 features the capability to program 35 keys, buffered I/O (input/output) on either RS-232C port, programmable handshaking modes, and automatic repeat on all keys. A real-time clock is included.

SB/E version 4 is available for standard and quad-density SuperBrains, for DOS versions 3.0 or later. The price is $195.

For additional information, contact IE Systems Inc, 98 Main St, POB 305, Newmarket NH 03857, (603) 659-5891.

Circle 529 on inquiry card.

Dow Jones Service for TRS-80

Owners of TRS-80 microcomputers and Videotex equipment can now access information services from the Dow Jones Corporation. The service's data base contains current and past news stories from the **Dow Jones News Service, The Wall Street Journal**, and **Barron's National Business and Financial Weekly** (all Dow Jones Company Inc publications). The service includes price quotations on more than 6000 stocks and other securities and offers access to revenues, earnings, dividends, price-earnings ratios, and stock-price performace on 3200 companies and 180 industries.

The package is designed for the Models I, II, III, the Color Computer, and the Videotex terminal. If you purchase the Videotex software ($29.95), terminal ($399), and terminal software ($19.95), you can receive one hour of the Dow Jones service free. Previous purchasers of Radio Shack's old Videotex package are also entitled to one free hour. This package is available from Radio Shack Computer Centers. Contact Radio Shack, 1800 One Tandy Ctr, Fort Worth TX 76102, (817) 390-3568.

Circle 530 on inquiry card.

Pascal Programmer

The Pascal Progammer provides development modules for those knowledgeable in UCSD Pascal. Designed to lessen coding, testing, and debugging, the program provides source listings, examples, ideas and instructions for modifications, and all needed operating instructions. It contains two floppy disks with source code, library units, and demonstration and utility programs. The Pascal Programmer costs $90 from the Denver Software Company, 36 Steele St, Suite 19, Denver CO 80206, (303) 321-4551.

Circle 531 on inquiry card.

Jim-pak® electronic components
Belmont, California 94002

One-Stop Component Center 

This is a partial listing of over 500 items available from 500 authorized Jim-pak Distributors:

TTL

7400	2/.85	7490	.85
7402	2/.85	7493	.85
7404	2/.85	74100	2.25
7406	2/1.19	74109	2/1.19
7407	2/1.19	74121	.69
7408	2/.89	74123	.99
7410	2/.85	74150	1.95
7414	.99	74154	1.95
7417	2/1.10	74157	.99
7420	2/.85	74161	1.19
7447	1.19	74164	1.59
7474	.69	74174	1.59
7475	.79	74175	1.49
7476	.69	74192	1.19
7485	1.19	74193	1.19
7486	2/1.19	74367	.99
7489	2.99	74393	1.95

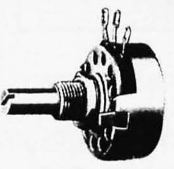
GRAB BAGS

GB100 Cer. Caps. (100)	2.95	GB123 Heat Sinks (30)	3.95
GB101 Mylar Caps. (60)	4.95	GB127 Transistors (100)	3.95
GB102 Electrolytics (60)	4.95	GB137 Chokes (50)	3.95
GB103 Tantalums (40)	4.95	GB139 Term. Strips (40)	3.95
GB108 TTL IC's (50)	4.95	GB140 Spcr/Stndff (150)	2.95
GB110 Asst. LEDs (100)	5.95	GB141 Washers (200)	2.95
GB113 Trimmers (30)	4.95	GB145 Lugs (100)	2.95
GB116 ¼w Resist. (200)	2.95	GB154 1&2w Resist. (100)	2.95
GB117 ½W Resist. (200)	2.95	GB162 7-Seg. Dsplys. (50)	5.95
GB120 Slide Switch (25)	3.95	GB173 3/8" Pots. (100)	5.95

LS Schottky

74LS00	.55	74LS109	.79
74LS02	.55	74LS123	1.95
74LS04	.69	74LS138	1.49
74LS08	.55	74LS139	1.49
74LS10	.55	74LS154	2.49
74LS14	1.09	74LS157	1.49
74LS30	.55	74LS161	1.79
74LS32	.69	74LS174	1.79
74LS38	.69	74LS175	1.79
74LS42	1.49	74LS192	1.89
74LS47	1.49	74LS193	1.89
74LS48	1.79	74LS221	1.95
74LS73	.79	74LS244	2.49
74LS74	.79	74LS245	3.49
74LS75	.99	74LS367	1.29
74LS85	1.95	74LS374	2.49
74LS90	1.09	81LS97	2.49

POTENTIOMETERS





2 Watt @ 70°C 7/8" Slotted Shaft Linear Taper	3/4 Watt @ 70°C 15 Turn Pot. Linear Taper
1K 5K 10K 25K 50K 100K 1 Meg	100Ω 500Ω 1K 5K 10K 50K 100K 500K 1Meg
CMU . . $2.95	830P . . $1.79

NEW! JE215 Adjustable Dual Power Supply

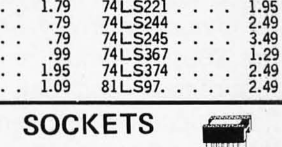
General Description: The JE215 is a Dual Power Supply with independent adjustable positive and negative output voltages. A separate adjustment for each of the supplies provides the user unlimited applications for IC current voltage requirements. The supply can also be used as a general all-purpose variable power supply.

FEATURES:
- Adjustable regulated power supplies, pos. and neg. 1.2VDC to 15VDC.
- Power Output (each supply): 5VDC @ 500mA, 10VDC @ 750mA, 12VDC @ 500mA, and 15VDC @ 175mA.
- Two, 3-terminal adj. IC regulators with thermal overload protection.
- Heat sink regulator cooling
- LED "on" indicator
- Printed Board Construction
- 120VAC input
- Size: 3-1/2"w x 5-1/16"L x 2"H

JE215 Adj. Dual Power Supply Kit (as shown) . . $24.95

(Picture not shown but similar in construction to above)
JE200 Reg. Power Supply Kit (5VDC, 1 amp) . . $14.95
JE205 Adapter Brd. (to JE200) ±5,±9 & ±12V . . $12.95
JE210 Var. Pwr. Sply. Kit, 5-15VDC, to 1.5amp . . $19.95

SOCKETS



Low Profile		Wire Wrap	
8 pin LP	2/.59	14 pin WW tin	.75
14 pin LP	2/.69	14 pin WW gold	1.09
16 pin LP	2/.79	16 pin WW tin	.79
18 pin LP	2/.89	16 pin WW gold	1.19
20 pin LP	2/.99	24 pin WW gold	1.69
22 pin LP	2/1.09	40 pin WW gold	2.75
24 pin LP	.79	14 p. plug/cover	1.29
28 pin LP	.82	16 p. plug/cover	1.39
36 pin LP	.99	24 p. plug/cover	1.95
40 pin LP	1.19	Also, The Molex Line	

DIODES & TRANSISTORS

IN751	2/.59	2N2219A	2/1.19
IN757	2/.59	2N2222A	2/.89
IN1188	2.69	2N2907A	2/.89
IN3600	5/.99	2N3055	.99
IN4001	4/.59	2N3772	2.25
IN4004	4/.69	2N3904	2/.69
IN4007	4/.79	2N3906	2/.69
IN4148	10/.99	2N4401	2/.79
IN4733	2/.69	2N4403	2/.79
IN4734	2/.69	2N5129	2/.69
IN4735	2/.69	2N5139	2/.69
IN4742	2/.69	2N5210	2/.79
IN4744	2/.69	2N5951	2/1.29

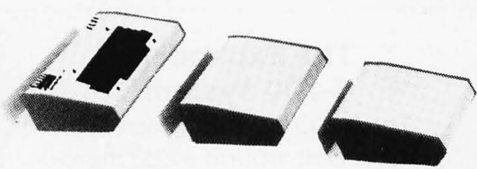
CMOS

4000	.69	4030	.79
4001	.69	4040	1.95
4002	.69	4044	1.39
4006	1.95	4046	2.49
4009	.89	4047	2.75
4010	.85	4049	.89
4011	.69	4050	.89
4013	.85	4051	1.95
4016	.85	4066	1.19
4017	1.49	4069	.79
4018	1.49	4070	.79
4020	2.19	4071	.79
4023	.49	4081	.69
4024	1.29	4093	1.19
4027	.89	4511	1.95

CAPACITORS

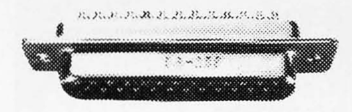
Dipped Tantalum		ELECTROLYTIC	
.1mfd@35V	2/.89	1mfd@50V	3/.69
.47mfd@35V	2/.89	4.7mfd@50V	2/.59
1mfd@35V	2/.89	10mfd@50V	2/.69
2.2mfd@25V	2/1.09	22mfd@50V	2/.79
3.3mfd@25V	2/1.19	47mfd@50V	2/.89
4.7mfd@25V	2/1.39	100mfd@50V	.59
10mfd@25V	1.19	220mfd@50V	.69
33mfd@25V	3.95	1000mfd@25V	1.19
100V MYLAR		2200mfd@16V	1.39
.001-.01mfd	4/.79	**50V CERAMIC**	
.022mfd	4/.89	10pf-.022mfd	4/.59
.047mfd	4/.99	.047mfd	4/.69
.1mfd	4/1.19	.1mfd	4/.79
.22mfd	4/1.29		

DESK TOP ENCLOSURES



DTE-8 (Pictured) $31.95
DTE-11 (Pictured) 34.95
DTE-14 . . . . . 36.95
DTE-HK (Case for JE600) 47.95
DTE-AK (Case for JE610) (Pictured) . . . 52.95

CONNECTORS

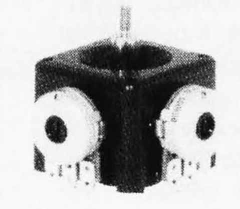


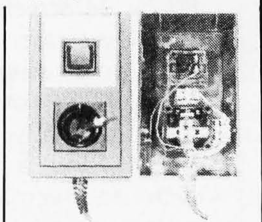
DB25P	D-Subminiature Plug	3.95
DB25S	D-Subminiature Socket	4.95
DB51226	Cover for DB25P/S	2.25
22/44SE	P.C. Edge	2.95
UG88/U	BNC Plug	2.19
UG89/U	BNC Jack	3.95
UG175/U	UHF Adapter	.59
SO239	UHF Panel Recp.	1.49
PL258	UHF Adapter	1.95
PL259	UHF Plug	1.95
UG260/U	BNC Plug	2.39
UG1094/U	BNC Bulkhead Recp.	1.49

MICROPROCESSORS

Z80A	CPU (4MHz)	14.95
MC6800	8 Bit MPU	14.95
8080A	CPU	6.95
8212	8 Bit I/O Port	3.95
8216	Bi-Directional Bus Driver	4.49
2513/2140	Character Generator	12.95
8T97	Tri-State Hex Buffer	2.25
AY-5-1013	30K Baud UART	6.95
AY-5-2376	88-Key Keyboard Encoder	13.95
2114-3	4K Static RAM (300ns)	6.95
MK4116	16K Dynamic RAM (250ns)	4.95
2708	8K EPROM	6.95
2716	16K EPROM (+5V)	10.95

JOYSTICKS





JS-100K 100K Linear Taper Pots $5.49
JVC-40 40K (2) Video Controller 5.95

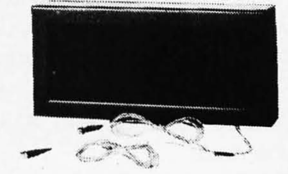
LINEAR

LM301N	.59	LM7805T	1.75
LM305H	1.39	LM7812T	1.75
LM307N	.75	LM7815T	1.75
LM308N	1.19	LM380N	1.49
LM309K	2.25	LM384N	2.49
LM310N	2.69	LM555N	.69
LM311N	1.49	LM556N	1.49
LM317T	2.29	LM565N	1.95
LM318N	2.95	LM566N	1.95
LM319N	2.95	LM567N	1.79
LM320K-5	2.25	LM723N	.79
LM7905T	1.75	LM741N	.65
LM7912T	1.75	LM1310N	2.95
LM7915T	1.75	LM1458N	.99
LM323K	5.95	LM1488N	1.59
LM324N	1.29	LM1489N	1.59
LM337T	2.29	LM1800N	4.49
LM339N	1.29	76477N	3.95

WALL TRANSFORMERS

AC250 250mA 12VAC (117V/60Hz) . . . $3.95
DV9200 200mA 9VAC (117V/60Hz) . . . 3.95

Digital Thermometer Kit



Dual sensors — switching control for indoor/outdoor or dual monitoring. Continuous LED .8" ht. display. Range: -40°F to 199°F / -40°C to 100°C. Accuracy ±1° nominal. Set for Fahrenheit or Celsius. Simulated walnut case. AC wall adapter included. Size: 3¼"h x 6-5/8"w x 1-3/8"d.

JE300 . . . . $39.95

Circle 411 on inquiry card.

What's New?

SYSTEMS

Introducing the Ensign

The Ensign microcomputer can support up to sixteen printers or video terminals. It includes a 6 MHz Z80B, 64 K bytes of programmable memory, and two extra Z80s to handle serial I/O (input/output) and disk and tape I/O. Supported software includes MP/M, CP/M, OASIS, and MVT-FAMOS.

The Ensign microcomputer with eight serial I/O ports and 2 megabytes of hard-disk storage costs $7000. Contact Integrated Business Computers, 22010 S Wilmington Ave, Carson CA 90745.

Circle 532 on inquiry card.

Graphics Color System

The MicroAngelo Graphics Color System offers 512 by 480 dot resolution and a choice of up to 256 colors. The system has a user-programmable color lookup table. This Z80-based, S-100 system allows overlays using a bit-plane technology that places no load on the host computer.

With the color system, Scion includes a CP/M package and Colorpak 1, which provides a high-level language interface. The price for the MicroAngelo Color System ranges between $2495 and $8495.

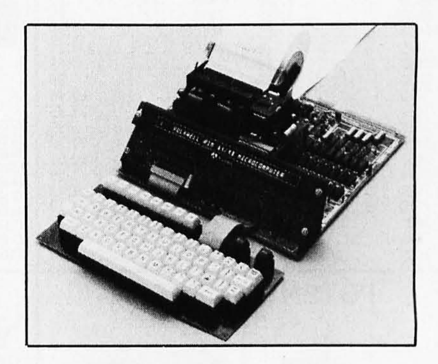
Also available is a $400 EPROM (erasable programmable read-only memory) called the Colorpak II. The Colorpak II doubles character generation, includes split-screen editing, a self-diagnostics routine, and a light-pen interface.

Contact Scion Corporation, 8455-D Tyco Rd, Vienna VA 22180, (703) 827-0888.

Circle 533 on inquiry card.

AIM-65/40

The AIM-65/40 microcomputer is made up of a 6502-based processor board with on-board expansion to 48 K bytes of programmable memory and 32 K bytes of ROM (read-only memory) or EPROM (erasable programmable ROM). It features a 40-column printer with a 280 by N dot matrix and an ASCII (American Standard Code for Information Interchange) keyboard with user-assignable function keys. Six-level priority-interrupt logic and six 16-bit timers are included. Other features include an RS-232C interface with data rates of up to 19 K bps (bits per second), a 20 mA current-loop TTY (teletypewriter) interface, dual audio-cassette interfaces, two user-definable 8-bit parallel ports with handshake control, and an 8-bit serial shift register. I/O (input/output) drivers are resident in ROM.



The printer contains a Centronics-compatible connector, provides upper- and lowercase ASCII characters, graphics character font, and uses a separate microprocessor. The display module uses a vacuum fluorescent 40-character display. Assembler and other language packages are available.

The price of the AIM-65/40 Model 5000 is $1795. In module form, the single-board computer costs $1195, the printer is $375, the display is $340, and the keyboard is $125. Contact Rockwell International, Electronic Devices Division, 3310 Miraloma Ave, POB 3669, Anaheim CA 92803, (714) 632-2321.

Circle 534 on inquiry card.

The Expander S-100 System

The S-100 Expander microcomputer is built around a Z80 microprocessor. The system has keyboard, video and interrupt circuitry, a real-time clock, parallel printer and RS-232C interfaces, and color capabilities. There is an 80 by 24 screen format, upper- and lowercase, 4 K-byte ROM (read-only memory) monitor, 64 K bytes of programmable memory that's expandable to 512 K, and a tone generator with an internal speaker. The system comes with Microsoft's 24 K BASIC-80 on disk and 10 K BASIC-80 on cassette.

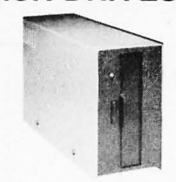


All CP/M and MP/M software written for the Z80 and other Z80 operating systems will run on the Expander. Additional slots are provided for more S-100 boards. An external video monitor is required. The price is under $2200 from Micro-Expander Inc, 6835 W Higgins Ave, Chicago IL 60656, (312) 792-1196.

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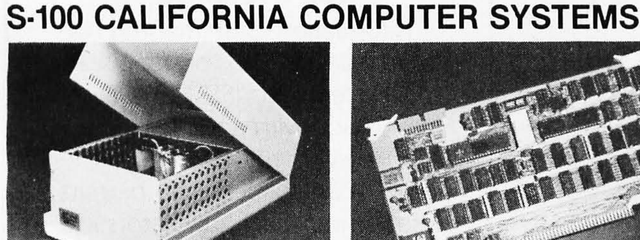
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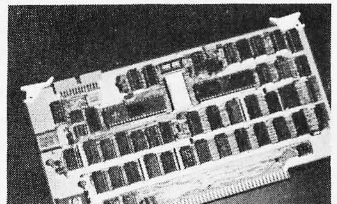
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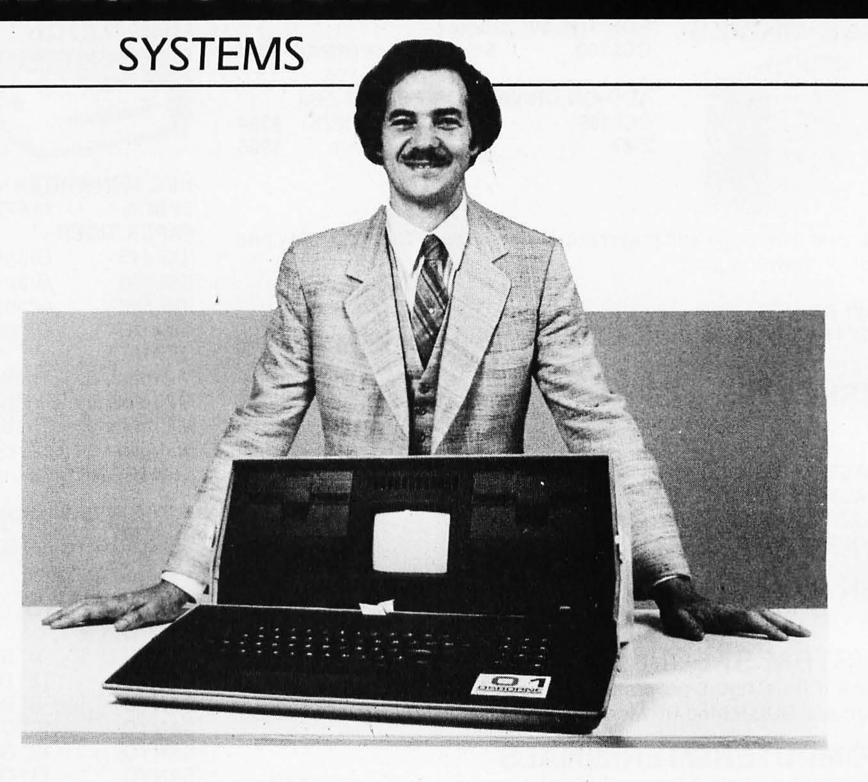
Circle 93 on inquiry card.

What's New?

SYSTEMS

The Osborne Microcomputer

The Osborne 1 is a portable, briefcase-sized microcomputer. It features a Z80A microprocessor and a video terminal with a 5-inch monitor that displays 52 columns and 24 lines. There are 64 K bytes of programmable memory, serial and IEEE-488 interfaces, dual 100 K-byte floppy-disk drives, and the WordStar word-processing program with the MailMerge option, CP/M, CBASIC and MBASIC, and the SuperCalc program. The monitor is a window on a 128 by 34 row screen, which is implemented in a 4 K by 9-bit programmable memory. In addition, pockets are included for storing up to 20 floppy disks.



Options include double-density, double-sided floppy-disk drives, 9- and 12-inch monitors, a battery pack providing three to five hours of operation, modem electronics, and an acoustic coupler.

The Osborne 1 costs $1795.

Contact Osborne Computer Corporation, 26500 Corporate Ave, Hayward CA 94545, (415) 887-8080.



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The FSST costs $2795 and is available from Triformation Systems Inc, 3132 SE Jay St, Stuart FL 33494, (305) 283-4817.

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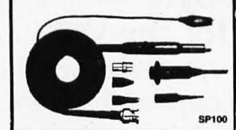
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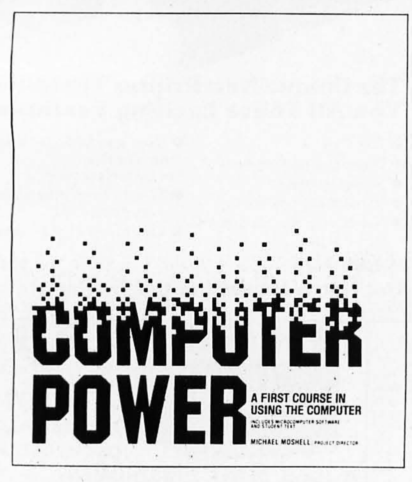
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Computer Power

Computer Power is a new computer-literacy curriculum from the Gregg Division of McGraw-Hill. Based on a unique Pascal interpreter, the materials in each package include: Rascal, an extended version of UCSD Pascal including enhanced graphics and music commands as well as animation; INTERPAS, the Pascal interpreter which allows students to program in Pascal as easily as BASIC by providing an immediate execution mode, single-stepping of programs, extensive error-handling facilities, single-key entry of command words, simplified editing and filing procedures, and the ability to convert debugged INTERPAS programs into standard Pascal programs; and a student text that includes program listings and materials to provide extended learning experiences for each lesson. Also included is an extensive teacher's manual written with the computer-naive teacher in mind. The manual provides complete lesson plans, a step-by-step guide to lesson objectives, instructional activities, instructions on how to use the computer in each lesson, a tutorial on using the computer and the accompanying software, and sections on classroom organization, management, and grading.

Computer Power runs on a 48 K-byte Apple II computer with the Language System, one disk drive, and a color monitor. For more information, contact Computer Power, Gregg/McGraw-Hill (29th floor), 1221 Avenue of the Americas, New York NY 10020.

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Memory Board from North Star

The HRAM memory boards are designed for North Star systems. The boards feature memory-parity checking and bank-switching capabilities. The boards are Horizon-compatible, and are available in 32 K-, 48 K-, and 64 K-byte configurations.

The boards range in price from $599 for the 32 K-byte board to $1099 for the 64 K-byte board. For more details, contact North Star Computers Inc, 14440 Catalina St, San Leandro CA 94577, (415) 357-8500.

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8 K-Byte Memory for the VIP

The RCA VIP single-board microcomputer can now have an extra 8 K bytes of programmable memory. The VP-575 System Expansion Board uses 2114 integrated circuits, addresses each 4 K-byte block separately, plugs into the VIP expansion connector or system expansion board, and draws 600 mA from a +5 V supply. The VP-575 costs $149 assembled and tested, and the bare board is $49. Contact G J Krizek, 722 N Morada Ave, West Covina CA 91790.

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Protecting Apple Software

The Soft Key system is a hardware-oriented antipiracy system for Apple software. The patent-pending system features a set of techniques that can be used by programmers to create their own security schemes. The custom algorithm used in the system is embodied in a non-copyable "key." The key, a custom integrated circuit, is plugged into a master security board to create a protection algorithm unique to the particular program.

The master board, which plugs into the Apple motherboard, is available in 1-, 8-, or 16-key versions, allowing the protection keys for several programs to coreside in the computer. The company claims that its protection scheme causes no significant slowdown in execution time of a program.

The protection key can be used to protect floppy disks, hard disks, and computer-network software. Programs written in Applesoft, Integer BASIC, Pascal, FORTRAN, and the various languages used in conjunction with the Microsoft Softcard, can all be protected by the Soft Key system.

The company charges an initial fee to instruct programmers in the techniques of using the system; program details need not be disclosed to Soft Key to protect the program. The OEM (original equipment manufacturer) price of the product is approximately $18 in quantity for a single keyboard with one custom key. Contact Soft Key Associates Inc, 44 Front St, Ashland MA 01721.

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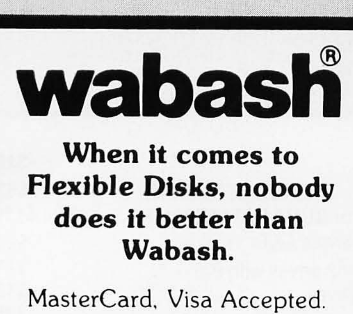
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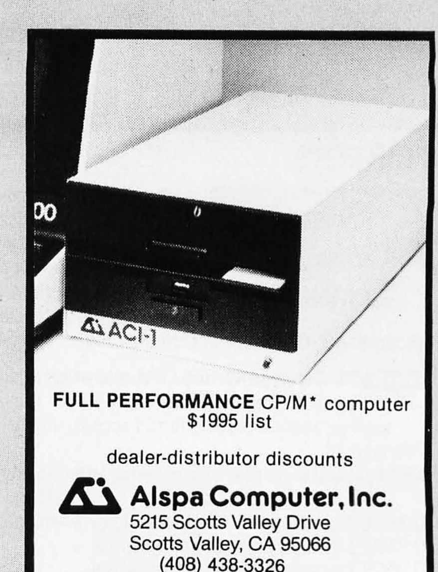


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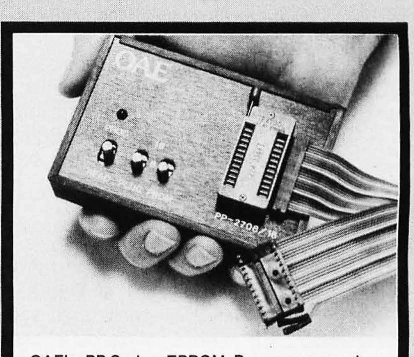
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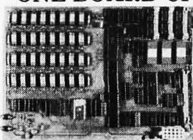


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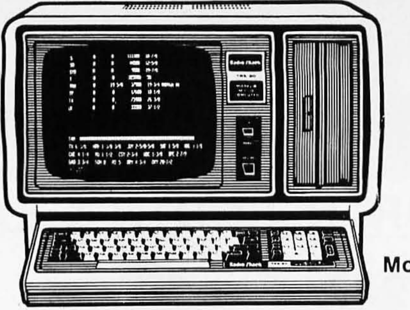
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26-1062	Model III 16K	999.00	865.00	865.00	134.00
26-1063	Model III 32K	2,495.00	2,243.50	2,199.00	296.00
Radio Shack® TRS-80 Color Computer					
26-3001	4K Color Computer	399.00	359.10	359.10	39.90
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Pan American Electronics

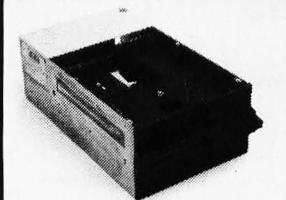
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Mitsubishi!!!!!! $649
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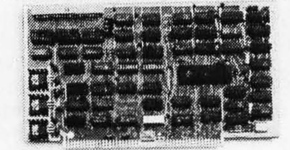
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Shugart 800/801R.....$425 - 2/$820

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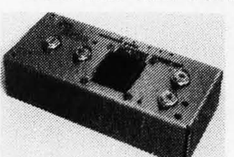
Siemens FDD100-8D$395 – 2/$755

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Circle 128 on inquiry card.

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3205	3.95	4014	1.39	4071	.35	74C00	.39	74LS13	.47	74LS148	1.49	74LS266	.59
3242	10.00	4015	1.15	4072	.35	74C02	.39	74LS14	1.25	74LS151	.79	74LS273	1.75
8155	11.25	4016	.59	4073	.35	74C04	.39	74LS15	.39	74LS153	.79	74LS275	4.40
8185	29.95	4017	1.19	4075	.35	74C08	.49	74LS20	.26	74LS155	1.19	74LS279	.59
8185-2	39.95	4018	.99	4076	1.29	74C10	.49	74LS21	.38	74LS156	.99	74LS283	1.10
8202	45.00	4019	.49	4078	.35	74C14	1.65	74LS22	.38	74LS157	.99	74LS290	1.29
8205	3.95	4020	1.19	4081	.35	74C20	.39	74LS26	.39	74LS158	.75	74LS293	1.95
8212	2.00	4021	1.19	4082	.35	74C30	.39	74LS27	.39	74LS160	.98	74LS295	1.10
8214	3.95	4022	1.15	4085	1.95	74C32	.99	74LS28	.39	74LS161	1.15	74LS298	1.29
8216	1.85	4023	.38	4086	.79	74C42	1.85	74LS30	.26	74LS162	.98	74LS324	1.75
8224	2.65	4024	.79	4093	.99	74C48	2.39	74LS32	.39	74LS163	.98	74LS347	1.95
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8238	5.45	4027	.65	4501	.39	74C85	2.49	74LS42	.79	74LS166	2.49	74LS353	1.65
8243	4.65	4028	.85	4502	1.65	74C89	4.95	74LS47	.79	74LS170	1.99	74LS363	1.49
8251A	5.55	4029	1.29	4503	.69	74C90	1.85	74LS48	.79	74LS173	.89	74LS365	.99
8253	9.85	4030	.45	4505	8.95	74C93	1.85	74LS51	.26	74LS174	.99	74LS366	.99
8255A	5.40	4031	3.25	4506	.75	74C95	1.85	74LS54	.35	74LS175	.75	74LS367	.73
8255A-5	5.40	4032	2.15	4507	.95	74C107	1.19	74LS55	.35	74LS181	2.20	74LS368	.73
8257	9.25	4033	2.15	4508	3.95	74C151	2.49	74LS73	.45	74LS190	1.15	74LS373	1.15
8257-5	9.25	4034	3.25	4510	1.39	74C154	3.50	74LS74	.59	74LS191	1.15	74LS374	2.75
8259A	7.30	4035	.95	4511	1.39	74C157	2.10	74LS75	.68	74LS192	.98	74LS375	.69
8271	60.00	4037	1.95	4512	1.39	74C160	2.39	74LS76	.45	74LS193	.98	74LS377	1.95
8275	32.95	4040	1.29	4514	3.95	74C161	2.30	74LS78	.65	74LS194	1.15	74LS385	1.95
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8279-5	10.80	4042	.95	4516	1.69	74C164	2.39	74LS85	1.19	74LS196	.89	74LS390	1.95
8282	6.70	4043	.85	4519	.99	74C173	2.59	74LS86	.45	74LS197	.89	74LS393	1.95
8283	6.70	4044	.85	4520	1.39	74C174	2.75	74LS90	.75	74LS221	1.49	74LS395	1.70
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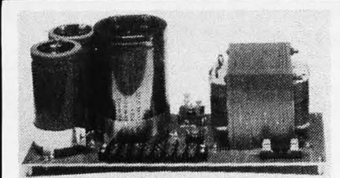
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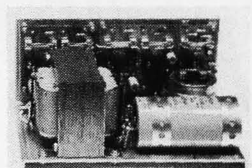
Circle 151 on inquiry card.

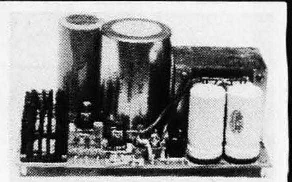
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FOR S-100, FLOPPY DISKS.


KIT 1, 2 & 3 For S-100


R3 For Three 8" or 5¼" Disk Drives


S3 2 in 1 Unit for S-100 and two 8" or 5¼" Disk Drives. It fits most Disk System Mainframes.

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KIT 2	SYSTEM SOURCE	25A	———	3A	3A	———	12" × 5" × 4⅞"	59.95
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DISK DRIVE POWER SUPPLY "R3" REGULATED, OPEN FRAME, ASSY. & TESTED 67.95

SPECS: + 5V @ 5A OVP, −5V @ 1A + 24V@ 5A, SHORTS PROTECT. 2 SIZES AVAIL., 1.) 9" (W) × 6¼" (D) × 4⅜" (H), 2) 9" (W) × 4⅞" (D) × 5¼" (H)
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REGULATED OUTPUTS FOR DISK DRIVES: +5V @ 4A, −5V @ 1A, +24V @ 4A (OR + 12V @ 4A). SHORTS PROTECT.
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A COMPLETE UNIT FOR DISK SYSTEM WITH THE MAINFRAME CONTAINING 12 SLOTS & TWO 8" or 5¼" DISK DRIVES.

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T_2	110/120	2 × 8 Vac, 25A	28 Vac, CT, 3.5A	———	3¾" × 4⅜" × 3⅛"	27.95
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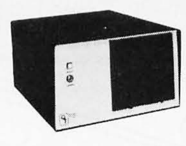
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Circle 244 on inquiry card.





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SYSTEM H+ and SYSTEM+

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62K Ram useable per user
MP/M multi-user DOS
Backup: 1 MByte floppy
Soon: Optional tape cartridge

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QT SYSTEM+

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64K Ram, EPROM monitor for RS-232
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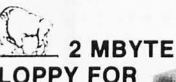
QT MINI-SYSTEM+



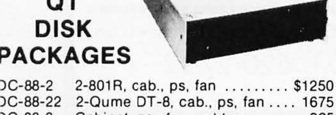
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QT DISK PACKAGES



DC-88-2	2-801R, cab., ps, fan	$1250
DC-88-22	2-Qume DT-8, cab., ps, fan	1675
DC-88-3	Cabinet, ps, fan, cables	325
DC-88-4	Cabinet only	58
hugart 801R		$390
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PI B-51		250
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31 MByte with CP/M 2.2
With S-100 controller
Cables, cabinet, power supply

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S-100 Single Board Computer

Z-80A, 2 or 4 MHz, switch
1K Ram, 1 parallel, 1 serial
EPROM monitor (specify)
DMA, programmable timers

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QT Z+80 CPU

• 2 or 4 MHz, switch
• Monitor with jump
• Serial port to 9600 baud

Brd ... $50 Kit ... $165 A&T ... $225

QT CLOCK/CALENDAR+
Apple, S-100, TRS-80
(Specify)

• Date, month, year
• Day of week, leap year
• 24 hour or AM-PM
• 4 interrupt intervals
• With software
• **Now with on-board battery**

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QT SILENCE+
S-100 Motherboards

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• Specify board, kit, or assembled

6-B	$25	8-B	$27	12-B	$30
6-K	40	8-K	55	12-K	70
6-A	50	8-A	70	12-A	90
18-B	$50	22-B	$75		
18-K	100	22-K	140		
18-A	140	22-A	190		

QT MAINFRAMES

• 18A power supply, S-100
• Drive power supply
• Specify motherboard slots
• Specify 8", 5¼" or no floppy

2-8" Floppy w/motherboard

MF8-6	$625
MF8-8	650
MF8-12	675

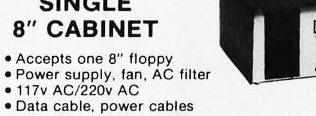
2-5¼" Floppy—w/Motherboard

MF5-6	$450
MF5-12	500

No Floppy—w/Motherboard

MF+12	$450
MF+18	500
MF+22	600

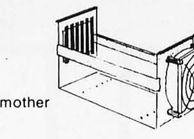
QT SINGLE 8" CABINET



• Accepts one 8" floppy
• Power supply, fan, AC filter
• 117v AC/220v AC
• Data cable, power cables

DDC+8 .... $175

QT S-100 CARD CAGES



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• Accepts silence + mother
• With card guides
• Accepts 4" fan
• Specify with mother, with fan

6 Slot (5¾w x 10⅛d x 6"h)

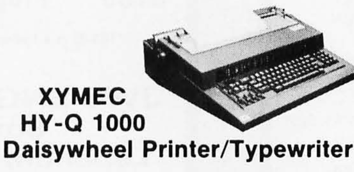
CC+6	$24
CC+6M	90
CC+6M/F	115

8 Slot (7¼w x 10⅛d x 6"h)

CC+8	$39
CC+8M	99
CC+8M/F	134

12 Slot (11½w x 10⅛d x 6"h)

CC+12	$61
CC+12M	114
CC+12M/F	149

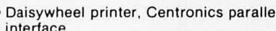


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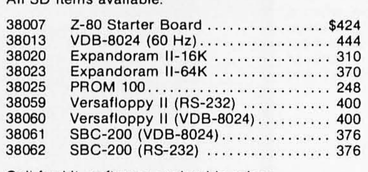
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38061	SBC-200 (VDB-8024)	376
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2210A	System	1600
2422A	Floppy Controller	360
2710A	4-Port Serial	289

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7114A	12K ROM/PROM Board	$68
7440A	Programmable Timer	97
7470A	A/D Converter	102
7490A	GPIB IEEE-488	255
7500A	Wire Wrap Board	20
7510A	Solder Tail Board	21
7520A	Extender Board	25
7710A	Serial Asynch Board	136
7728A	Centronics Parallel Bd	105
7811B	Arith Processor - disk	355
7811C	Arith Processor - ROM	355

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FDC-1	Single Board Computer	$685
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$1000 — PL/C Compiler, Runtime Library, Compiler PL/C Source, and PL/C Source Code for a PL/C Compiler Version which produces PROCESSOR-INDEPENDENT macro source.

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A PL/C information package is available for $25

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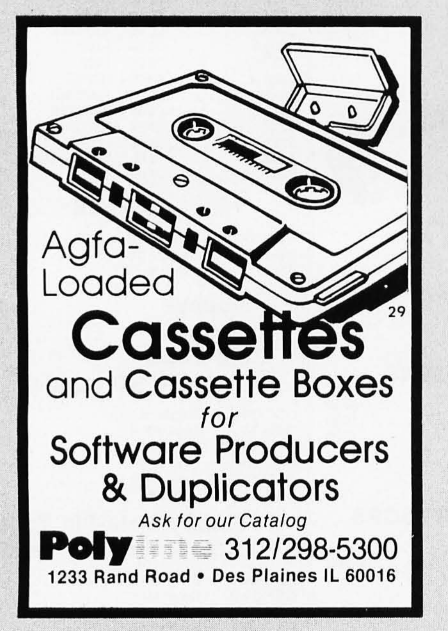
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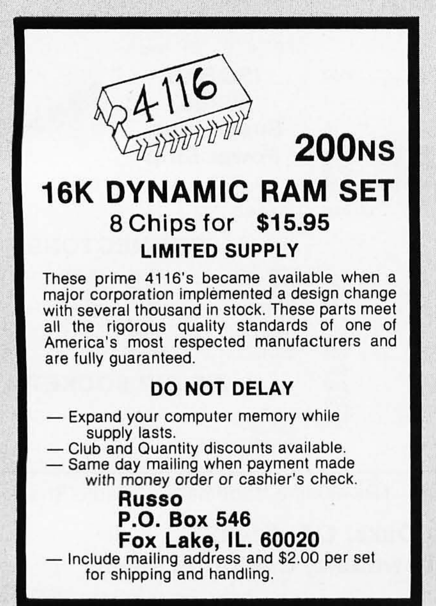
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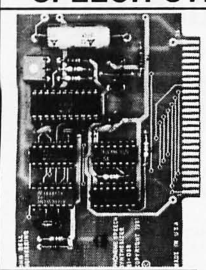
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NEW

PARALLEL INPUT

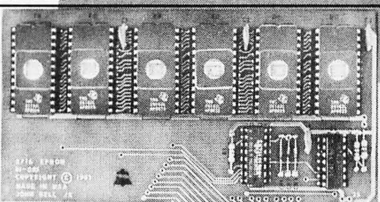
Documentation includes basic user programs, a phoneme chart and a listing of coded words to help you get started.

Documentation for the Apple II® Speech Synthesizer includes a disk with many user programs.

*Because of the high cost of the SC-01 at this time, it will be sold separately. In this way, as the price goes down, we can pass the savings on directly to you.

81-088	Apple II® Speech Synthesizer	**$79.95**
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SC-01	Phoneme Synthesizer Chip	**$59.95**

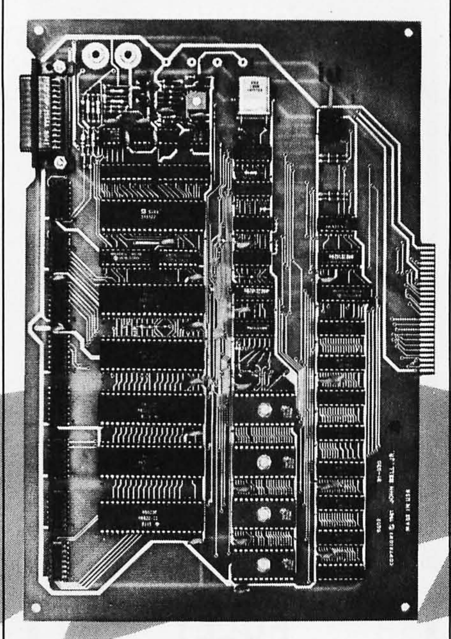
EPROM EXPANSION CARD



JBE EPROM Expander for the Apple II holds six 5 volt 2716s for a total of 12K bytes of ROM. This board takes the place of the on board ROM in the Apple. It is software switchable by the same technique used by the Apple® II firmware card. Solder jumpers are for reset to the Apple ROM or 2716s on the card. (EPROMs available separately). Use JBE EPROM programmer and parrallel I/O cards to program your EPROMS.

81-085K	Kit	**$49.95**
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JBE's 7 ¾" x 11 ¾" 6502 base Microcomputer has the capacity for 16K of EPROM, 4K of RAM, 8 Parallel Ports and 1 Serial Port. Monitor and Tiny Basic are also available. The fully populated version includes:

- 1 6502 CPU
- 4 6522 VIA (8 Parallel I/O Ports)
- 1 AY5-1013 (Serial I/O Ports)
- 8 2114 RAM (4K)
- 2 2716 EPROM (monitor & tiny basic)

The partially populated version includes:

- 1 6502 CPU
- 1 6522 VIA (2 Parallel I/O Ports)
- 1 AY5-1013 (Serial I/O Port)
- 2 2114 RAM (1K)
- 1 2716 EPROM (with monitor)

Both versions include sockets for 4 2716s or 2732s, 8 16 pin sockets for I/O interfacing and a DB25 connector for RS232.

All address and data lines, power supply, RDY, interrupts, DMA, phase 1 & phase 2 clock, R/W, reset and NMI & IRQ are brought off the board to the 50 pin edge connector. (similar to the Apple II® bus)

This board also features power on reset and cassette interface.

Documentation includes 6502 programming manual & Complete doc. for the 6522 VIA. Also included is doc. for interfacing with JBE A-D & D-A Converter, Solid State Switches, EPROM Programmer & Parallel Input Speech Synthesizer.

81-030C Fully Populated JBE I	**$349.95**
81-030M Partially Populated JBE I	**$249.95**
81-030B Bare Board JBE I (Doc.Incl.)	**$ 89.95**
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NEW

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81-132K Kit	**$69.96**
81-132A Assm. & Tested	**$89.95**

REAL TIME CLOCK



JBE's Real Time Clock Card for the Apple II® computer has automatic leap year calculation, month & date and can time down to .1 sec. It uses an MM58174 Real Time Clock chip, has interrupt capability and has separate time intervals of 60 sec, 5 sec & .5 sec. An on board 2716 holds 8 user programs which are switch selectable. A 32768 Hz crystal is used for accuracy. On board battery will keep correct time for up to one year.

81-135B Bare Board	**$ 39.95**
81-135K Kit	**$ 99.95**
81-135A Assm. & Tested	**$119.95**

EPROM SUBSTITUTION CARD



This board looks like RAM to the Apple® II and like an EPROM to the computer being programmed. It features 2K or 4K of RAM and emulates a 2716 or 2732. A 24 pin ribbon cable connects the computer being programmed to the EPROM sub. board. Documentation includes disk with basic & pascal utility routines including save, write, CMP, error checking. Complete Source Code User Manual also included. This board allows you to test programs without burning your EPROM. Three control lines from the board are used to control the computer being programmed (reset etc.)

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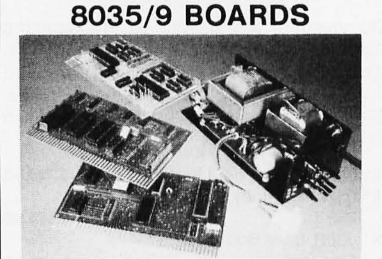
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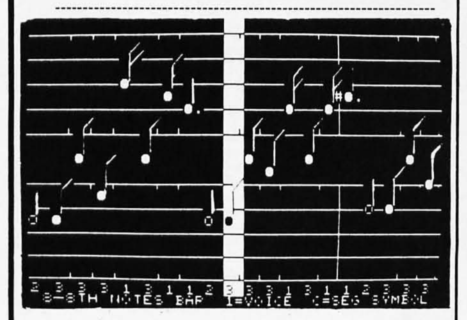
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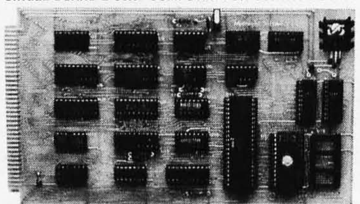
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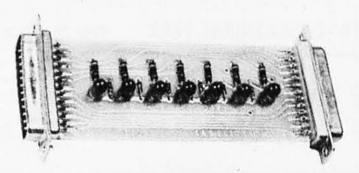
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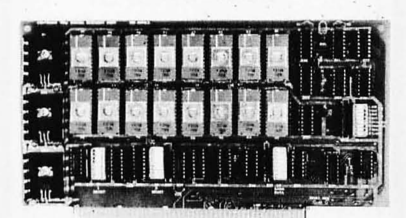
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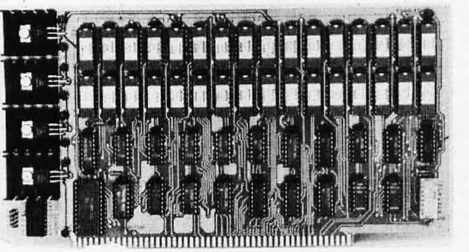
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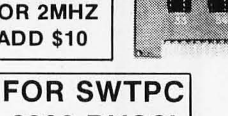
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.5390-B	5.610-B	9.98408-B	20.4988-B	36.3636-B	42.8768-B	47.3768-B
1.000-A	5.7143-B	9.98960-B	22.1184-B	37.9628-B	42.9258-B	47.8838-B
1.8432-A	5.955-B	10.000-B	22.6258-B	38.3768-B	42.9628-B	48.000-B
1.8437-B	5.982-B	10.2458-B	26.3556-B	38.4448-B	43.0008-B	48.3006-B
2.000-A	6.000-B	10.4968-B	26.5006-B	38.6258-B	43.0378-B	48.6668-B
2.0971-A	6.144-B	10.7755-B	26.6706-B	38.9258-B	43.0748-B	48.7006-B
2.4576-A	6.15030-B	10.8255-B	27.000-B	39.3128-B	43.1858-B	48.8768-B
2.500-A	6.29780-B	10.8386-B	27.0006-B	39.5038-B	43.2598-B	49.7006-B
2.6657-B	6.400-B	11.1360-B	27.6506-B	39.6668-B	43.3338-B	49.7338-B
2.9950-B	6.5536-B	11.155-B	28.4006-B	39.7538-B	43.3708-B	49.8128-B
3.000-A	6.72530-B	11.2186-B	28.6276-B	39.8768-B	43.4078-B	50.2505-B
3.067-B	6.75840-B	11.2890-B	28.7538-B	39.9628-B	43.4378-B	51.0556-B
3.200-B	6.9003-B	11.4776-B	29.8758-B	40.4448-B	43.4448-B	51.3128-B
3.2768-A	7.0063-B	11.6566-B	29.9378-B	40.5928-B	43.5558-B	51.7778-B
3.500-B	7.0336-B	11.6816-B	30.0648-B	40.8128-B	43.6298-B	51.8506-B
3.579-B	7.0916-B	12.440-B	30.3606-B	40.8336-B	43.6668-B	52.8128-B
4.000-B	7.1836-B	14.3182-B	30.6258-B	40.8758-B	43.7778-B	56.7506-B
4.1943-B	7.2586-B	14.4308-B	30.8768-B	40.8888-B	43.8128-B	60.6006-B
4.3426-B	8.000-B	15.000-B	31.4378-B	40.9258-B	43.8148-B	60.7508-B
4.4803-B	8.0556-B	15.4408-B	31.7538-B	41.0008-B	43.8518-B	66.7506-B
4.6103-B	8.1416-B	15.5066-B	31.9008-B	41.1666-B	43.8888-B	70.4006-B
4.6503-B	8.1818-B	16.000-B	32.000-B	41.3768-B	43.9258-B	75.0005-B
4.8303-B	8.3303-B	16.3848-B	33.2006-B	41.9378-B	44.0008-B	90.8338-B
4.9152-B	8.4998-B	17.2248-B	33.6258-B	42.0008-B	44.0378-B	99.9668-B
5.000-B	8.5766-B	17.2422-B	34.5558-B	42.5836-B	44.3768-B	100.6668-B
5.0688-B	8.6056-B	18.000-B	34.7538-B	42.6268-B	44.7778-B	101.4668-B
5.1203-B	8.9608-B	18.4320-B	34.9776-B	42.7006-B	45.1256-B	103.0668-B
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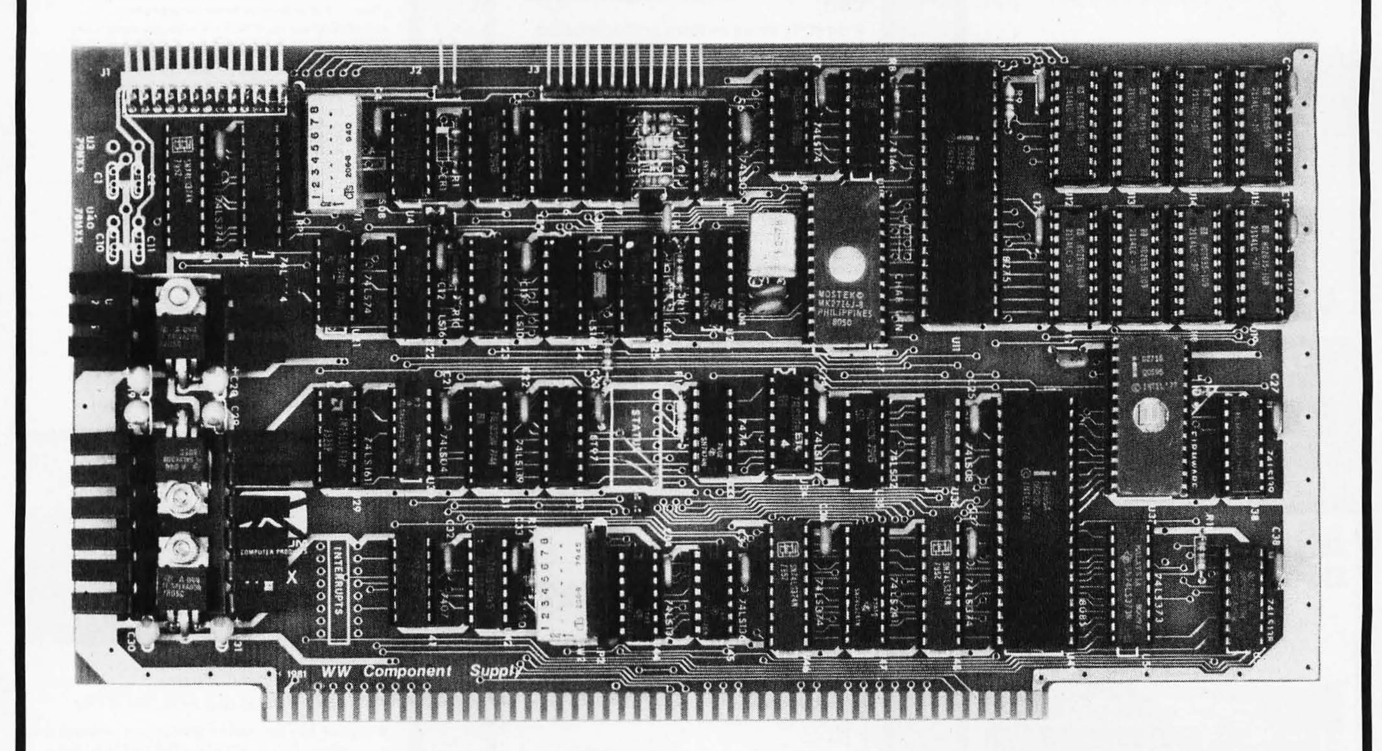


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VIO-X

The VIO-X Video I/O Interface for the S-100 bus provides features equal to most intelligent terminals both efficiently and economically. It allows the use of standard keyboards and CRT monitors in conjunction with existing hardware and software. It will operate with no additional overhead in S-100 systems regardless of processor or system speed.

Through the use of the Intel 8275 CRT controller with an onboard 8085 processor and 4k memory, the VIO-X interface operates independently of the host system and communicates via two ports, thus eliminating the need for host memory space. The screen display rate is effectively 80,000 baud.

The VIO-X1 provides an 80 character by 25 line format (24 lines plus status line) using a 5 × 7 character set in a 7 × 10 dot matrix to display the full upper and lower case ASCII alphanumeric 96 printable character set (including true descenders) with 32 special characters for escape and control characters. An optional 2732 character generator is available which allows an alternate 7 × 10 contiguous graphics character set.

The VIO-X2 also offers an 80 character by 25 line format but uses a 7 × 7 character set in a 9 × 10 dot matrix allowing high-resolution characters to be used. This model also includes expanded firmware for block mode editing and light pen location. Contiguous graphics characters are not supported.

Both models support a full set of control characters and escape sequences, including controls for video attributes, cursor location and positioning, cursor toggle, and scroll speed. An onboard Real Time Clock (RTC) is displayed in the status line and may be read or set from the host system. A checksum test is performed on power-up on the firmware EPROM.

Video attributes provided by the 8275 in the VIO-X include:

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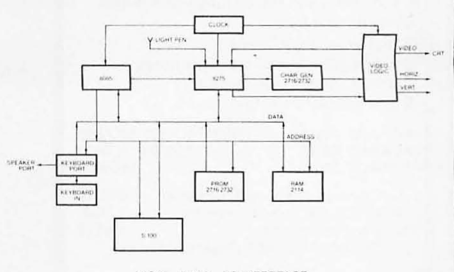
The above functions may be toggled together or separately.

The board may be addressed at any port pair in the IEEE 696 (S-100) host system. Status and data ports may be swapped if necessary. Inputs are provided for parallel keyboard and for light pen as well as an output for audio signalling. The interrupt structure is completely compatible with Digital Research's MP/M ®.

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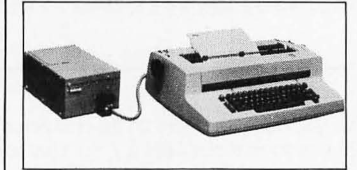
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HERE IS AN ACTUAL SAMPLE OF ELIZA'S CONVERSATIONAL ABILITY:
(ELIZA'S comments are printed in capital letters)

All men are alike.
IN WHAT WAY?

They're always bugging us about something or other.
CAN YOU THINK OF A SPECIFIC EXAMPLE?

Well, my boyfriend made me come here.
YOUR BOYFRIEND MADE YOU COME HERE - THAT'S INTERESTING.

I need some help, that much seems certain.
WHAT WOULD IT MEAN TO YOU IF YOU GOT SOME HELP?

Perhaps I could learn to get along with my mother.
TELL ME MORE ABOUT YOUR FAMILY.

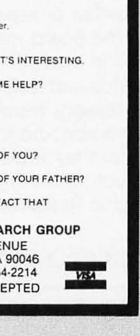
You are like my father in some ways.
WHAT RESEMBLANCE DO YOU SEE?

You are afraid of me.
DOES IT PLEASE YOU TO BELIEVE I AM AFRAID OF YOU?

My father is afraid of everybody.
WHAT ELSE COMES TO MIND WHEN YOU THINK OF YOUR FATHER?

Bullies.
DOES THAT HAVE ANYTHING TO DO WITH THE FACT THAT YOUR BOYFRIEND MADE YOU COME HERE?

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6800 6.95
6802 11.95
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8085 12.95
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8251 6.95
8253 15.00
8255 5.75
8257 10.95
8259 14.95
1802CP plas. 13.95
1802DP plas. 17.95
1861P 9.50
CDP1802CD 28.95
CDP1802D 35.00
CDP1816P 7.95

UART/FIFO
AY5-1013 5.50
AY5-1014 7.50
3341 6.95

PROM
1702A 5.85
2708 6.10
2716T1 12.00
2716 5 Volt 10.50
8/2716 5 Volt 64.00
2732 19.95
2758 14.00
8741A 55.00
8748 55.00
8748-8 55.00
8755A 55.00
N82S23 2.95
N82S123 4.95
N82S126 4.75
N82S129 4.95
N82S131 4.95
N82S136 8.75
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DM8577 2.90
8223 3.50

CONNECTORS
30 pin edge 2.50
44 pin edge 2.75
86 pin edge 4.00
100 pin edge 4.50
100 pin edge WW 5.25

IC SOCKETS
Solder Tin Low Profile

PIN	1 UP	PIN	1UP
8	.15	22	.30
14	.14	24	.35
16	.16	28	.42
18	.27	36	.58
20	.29	40	.57

2 level 14 pin ww .20

WIRE WRAP LEVEL 3

PIN		PIN	
14	.55	24	.93
16	.57	28	1.00
18	.67	40	1.59

CRYSTALS
1 MHz 4.50
2 MHz 4.50
4 MHz 4.25
5 MHz 4.25
10 MHz 4.25
18 MHz 3.90
20 MHz 3.90
32 MHz 3.90
32768 Hz 4.00
1.8432 MHz 4.50
3.5795 MHz 1.20
2.0100 MHz 1.95
2.097152 MHz 4.50
2.4576 MHz 4.50
3.2768 MHz 4.50
5.0688 MHz 4.50
5.185 MHz 4.50
5.7143 MHz 4.50
6.5536 MHz 4.50
14.31818 MHz 4.25
18.432 MHz 4.50
22.1184 MHz 4.50

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AY5-3600 17.95
AY5-9100 10.50
AY5-9200 16.50
74C922 5.50
74C923 5.50
HD0165-5 6.95
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DB25P 3.62
DB25S 5.20
Cover 1.67
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DA15S 3.10
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RESISTORS ¼ watt 5%
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25 per type .025
100 per type .015
1000 per type .012
350 piece pack 5 per type 6.75
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Cliplite LED Mounting Clips 8/$1.25
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PC board 7.50
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Model 150 Bus Grabber Kit $369.00
Clock Calendar Kit $23.95
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12 Volt 300 ma transformer 1.25
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10V 1.2 amp wall plug 4.85
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10/15 VAC 8/16 VA wall plug 9.75

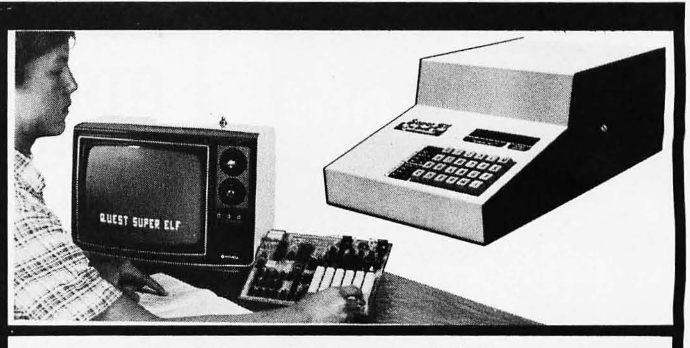
DISPLAY LEDS

MAN1	CA	.270	2.90
MAN3	CC	.125	.39
MAN72/74	CA/CA	.300	1.00
DL704	CC	.300	1.25
DL707/DL707R	CA	.300	1.00
DL727/728	CA/CC	.500	1.90
DL747/750	CA/CC	.600	1.95
FND359	CC	.357	.70
FND500/507	CC/CA	.500	1.35
FND503/510	CC/CA	.500	.90
FND800/807	CC/CA	.800	2.20
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TIL311 Hex			9.50
MAN3640	CC	.30	1.10
MAN4610	CA	.40	1.20
MAN4640	CC	.40	1.20
MAN4710	CA	.40	.95
MAN4740	CC	.40	1.20
MAN6640	CC	.56	2.95
MAN6710	CA	.60	1.35
MAN6740	CC	.60	1.35

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MA1012A 8.95
102P3 transformer 2.25
MA1012A Transformer 2.25

DIP Switches
4-position $ .95
5-position 1.00
6-position 1.00
7-position 1.00
8-position 1.05

4116 200ns Dynamic RAM
8/$18.40



RCA Cosmac 1802 Super Elf Computer $106.95

Compare features before you decide to buy any other computer. There is no other computer on the market today that has all the desirable benefits of the **Super Elf** for so little money. The Super Elf is a small single board computer that does many **big** things. It is an excellent computer for training and for learning programming with its machine language and yet it is easily **expanded** with **additional memory, Full Basic, ASCII Keyboards, video character generation, etc.**

Before you buy another small computer, see if it includes the following features: ROM monitor; State and Mode displays; Single step; Optional address displays; Power Supply; Audio Amplifier and Speaker; Fully socketed for all IC's; Real cost of in warranty repairs; Full documentation.

The **Super Elf** includes a **ROM** monitor for program loading, editing and execution with **SINGLE STEP for program debugging** which is not included in others at the same price. With **SINGLE STEP** you can see the microprocessor chip operating with the **unique Quest** address and data bus displays **before, during** and **after** executing instructions. Also, CPU mode and instruction cycle are decoded and displayed on 8 LED indicators.

An RCA 1861 **video graphics** chip allows you to connect to your own TV with an inexpensive video modulator to do graphics and games. There is a **speaker system** included for writing your own music or using many music programs already written. The speaker amplifier may also be used to drive relays for control purposes.

A 24 key **HEX keyboard** includes 16 HEX keys plus **load, reset, run, wait, input, memory protect, monitor select** and **single step**. Large, on board displays provide output and optional **high and low address**. There is a 44 pin standard connector slot for PC cards and a 50 pin connector slot for the Quest Super Expansion Board. Power supply and sockets for **all** IC's are included in the price plus a detailed 127 pg. instruction manual which now includes over 40 pgs. of software info. including a series of lessons to help get you started and a music program and graphics target game. Many schools and universities are using the Super Elf as a course of study. OEM's use it for training and R&D.

Remember, other computers only offer Super Elf features at additional cost or not at all. **Compare before you buy. Super Elf Kit $106.95, High address option $8.95, Low address option $9.95. Custom Cabinet** with drilled and labelled plexiglass front panel **$24.95.** All metal Expansion Cabinet, painted and silk screened, with room for 5 S-100 boards and power supply **$57.00. NiCad Battery Memory Saver Kit $6.95.** All kits and options also completely assembled and tested.

Questdata, a software publication for 1802 computer users is available by subscription for $12.00 per 12 issues. Single issues $1.50. Issues 1-12 bound $16.50.

Free 14 page brochure.

Moews Video Graphics **$3.50.** Games and Music **$3.00,** Chip 8 Interpreter **$5.50.**

Super Expansion Board with Cassette Interface $89.95

This is truly an astounding value! This board has been designed to allow **you** to decide how you want it optioned. **The Super Expansion Board comes with 4K of low power RAM** fully addressable anywhere in 64K with built-in memory protect and a **cassette interface.** Provisions have been made for all other options on the same board and it fits neatly into the hardwood cabinet alongside the **Super Elf.** The board includes slots for up to 6K of **EPROM** (2708, 2758, 2716 or TI 2716) and is **fully socketed.** EPROM can be used for the monitor and Tiny Basic or other purposes.

A IK Super ROM Monitor $19.95 is available as an on board option in 2708 EPROM which has been preprogrammed with a program loader/editor and error checking multi file cassette read/write software, (relocatable cassette file) another exclusive from Quest. It includes register save and readout, block move capability and video graphics driver with blinking cursor. Break points can be used with the register save feature to isolate program bugs quickly, then follow with single step. If you have the **Super Expansion Board** and **Super Monitor** the monitor is up and running at the push of a button.

Other on board options include **Parallel Input and Output Ports** with **full handshake.** They allow easy connection of an ASCII keyboard to the input port. **RS 232 and 20 ma Current Loop** for teletype or other device are on board and if you need more memory there are two **S-100** slots for static RAM or video boards. Also a 1K Super Monitor version 2 with video driver for full capability display with Tiny Basic and a video interface board. **Parallel I/O Ports $9.85, RS 232 $4.50, TTY 20 ma I/F $1.95, S-100 $4.50.** A **50 pin connector set** with ribbon cable is available at $15.25 for easy connection between the **Super Elf** and the **Super Expansion Board.**

Power Supply Kit for the complete system (see Multi-volt Power Supply).

Quest Super Basic V5.0

A new enhanced version of **Super Basic** now available. Quest was the first company worldwide to ship a full size Basic for 1802 Systems. A complete function **Super Basic** by **Ron Cenker** including floating point capability with scientific notation (number range $\pm.17E^{38}$), 32 bit integer ± 2 billion; multi dim arrays, string arrays; string manipulation; cassette I/O; save and load, basic, data and machine language programs; and over 75 statements, functions and operations.

New improved faster version including **renumber** and essentially **unlimited variables.**

Also, an exclusive user expandable command library.

Serial and Parallel I/O included.

Super Basic on Cassette $55.00.

PROM Eraser

assembled. 25 PROM capacity **$37.50** (with timer **$69.50**). 6 PROM capacity OSHA/UL version **$69.50** (with timer **$94.50**).

Z80 Microcomputer

16 bit I/O, 2 MHz clock, 2K RAM, ROM Breadboard space. Excellent for control. Bare Board **$28.50.** Full Kit **$99.00.** Monitor **$20.00.** Power Supply Kit **$35.00. Tiny Basic $30.00**

S-100 Computer Boards

8K Static Godbout Econo IIA Kit	149.00
16K Static Godbout Econo XIV Kit	269.00
24K Static Godbout Econo XX-24 Kit	414.00
32K Static Godbout Econo XX-32 Kit	537.00
16K Dynamic RAM Kit	289.00
32K Dynamic RAM Kit	328.00
64K Dynamic RAM Kit	399.00
Video Interface Kit	**$161.00**
Color Video Kit	129.95

81 IC Update Master Manual $79.95

Comp. IC data selector, 2 vol. master reference guide. Over 51,000 cross references. Free update service through 1981. Domestic postage $4.75.

Modem Kit $60.00

State of the art, orig., answer. No tuning necessary. 103 compatible 300 baud. Inexpensive acoustic coupler plans included. Bd. only $17.00. Article in May *Radio Electronics*.

LRC 7000+Printer $389.00

64/40/32/20 column dot matrix impact, std. paper. Interface all personal computers.

LRC 7000 printer interface cable for Super Elf with software $35.00

NiCad Battery Fixer/Charger Kit

Opens shorted cells that won't hold a charge and then charges them up, all in one kit w/full parts and instructions. **$9.95**

Rockwell AIM 65 Computer

6502 based single board with full ASCII keyboard and 20 column thermal printer. 20 char. alphanumeric display, ROM monitor, fully expandable. **$405.00.** 4K version **$450.00.** 4K Assembler **$85.00,** 8K Basic Interpreter **$100.00.**

Special small power supply for AIM65 assem. in frame **$54.00.** Complete AIM65 in thin briefcase with power supply **$499.00.** Molded plastic enclosure to fit both AIM65 and power supply **$47.50.** Special Package Price: 4K AIM, 8K Basic, power supply, cabinet **$625.00.**

AIM65/KIM/VIM/Super Elf 44 pin expansion board; 3 female and 1 male bus. Board plus 3 connectors **$22.95.**

60 Hz Crystal Time Base Kit $4.40

Converts digital clocks from AC line frequency to crystal time base. Outstanding accuracy.

Video Modulator Kit $9.95

Convert TV set into a high quality monitor w/o affecting usage. Comp. kit w/full instruc.

Multi-volt Computer Power Supply

8v 5 amp, ±18v .5 amp, 5v 1.5 amp, −5v .5 amp, 12v .5 amp, −12v option. ±5v, ±12v are regulated. Basic Kit **$35.95.** Kit with chassis and all hardware **$51.95.** Add $5.00 shipping. Kit of hardware **$16.00.** Woodgrain case **$10.00.** $1.50 shipping.

Ohio Scientific Computers

CIP Series 2 **$447.00.** Like an Apple at less than half the price! CIPMF Series 2 **$1199.00.** Minifloppy version with additional RAM/ROM. Complete software and peripherals available. Send for free brochure.

Gremlin Color Video Kit $69.95

32 x 16 alpha/numerics and graphics; up to 8 colors with 6847 chip; 1K RAM at E000. Plugs into Super Elf 44 pin bus. No high res. graphics. On board RF Modulator Kit **$4.95**

1802 16K Dynamic RAM Kit $149.00

Expandable to 32K. Hidden refresh w/clocks up to 4 MHz w/no wait states. Addl. 16K RAM **$25.00**

Tiny Basic Extended on Cassette $15.00
(added commands include Stringy, Array, Cassette I/O etc.) S-100 4-Slot Expansion $ 9.95
Super Monitor VI.I Source Listing $15.00

Elf II Adapter Kit $24.95

Plugs into Elf II providing Super Elf 44 and 50 pin plus S-100 bus expansion. (With Super Expansion). High and low address displays, state and mode LED's optional **$18.00.**

Super Color S-100 Video Kit $129.95

Expandable to 256 x 192 high resolution color graphics. 6847 with all display modes computer controlled. Memory mapped. 1K RAM expandable to 6K. S-100 bus 1802, 8080, 8085, Z80 etc.

Dealers: Send for excellent pricing/margin program.

Editor Assembler $25.00
(Requires minimum of 4K for E/A plus user source)
1802 Tiny Basic Source listing $19.00
Super Monitor V2.0/2.1 Source Listing $20.00

TERMS: $5.00 min. order U.S. Funds. Calif residents add 6% tax.
$10.00 min. BankAmericard and Master Charge accepted. $1.00 insurance optional.
Postage: Add 5%. C.O.D. $10.00 min. order.

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Citrus Heights, CA 95610

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Sacramento, CA 95826

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BASIC UTILITY SET

- EDITOR — Create & edit a Basic program using 26 commands, including GLOBAL locate & change.
- BPRT — Print & cross reference a Basic program.
- BPAK — Pack a Basic program.
- RE — Rename a disk file.

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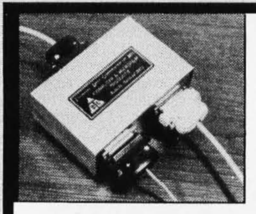
Get twice as much from your H88 or H89 microcomputer. Our FDC-880H floppy disk controller, in conjunction with your 5¼" drives, for example, expands memory capacity from 256 bytes to 512 bytes per sector.

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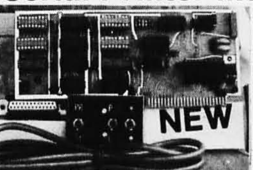
.1875 .375 .1875 .1406

100 pc. $40.00
500 pc. $35.00/c
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Input: 95, 115, 205, 220 VAC, 50/60 Hz.
Includes: UL Spec. Transformer, Rectifiers, Computer Grade Capacitors, RFI line filter, and Schematics.

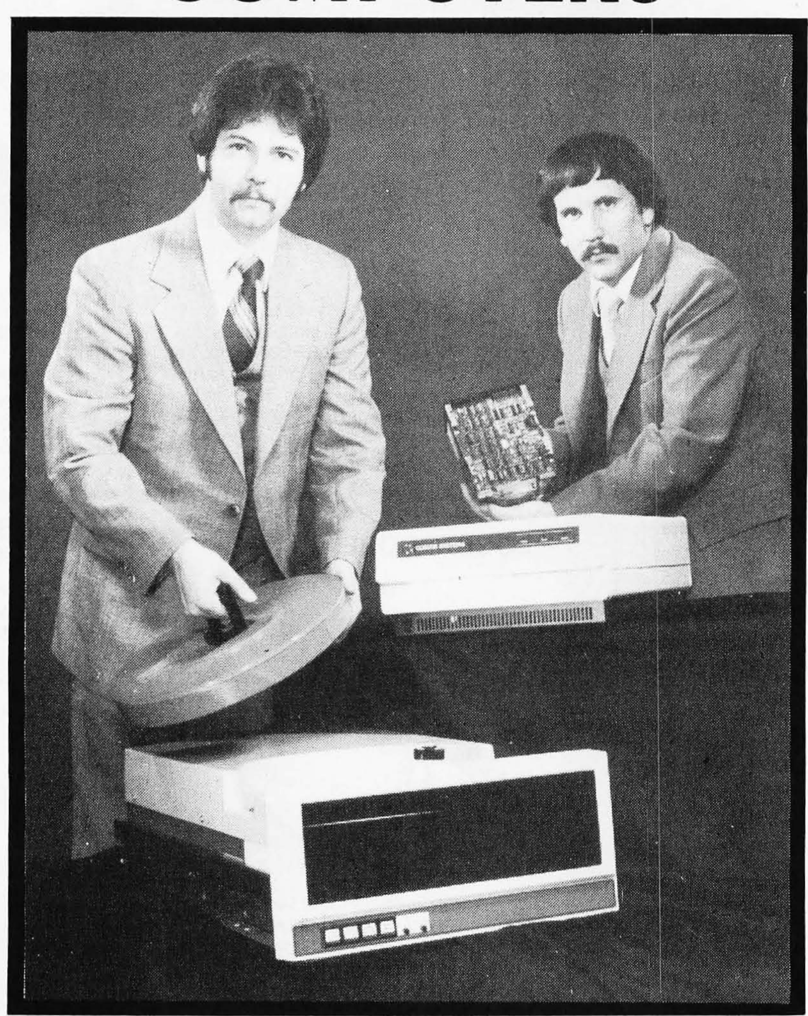
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The Cameo 10 Million Character Disk Drive Subsystem (pictured in foreground) Is A 5 Megabyte Fixed, 5 Megabyte Removable Cartridge-Type Disk Drive. Advantages To This Unit Are Ease of Backup For Data and Program Files and Low Cost. By Attaching A Multiplexor Unit Several Model II's Can Be Attached To The Cameo Disk Drive. For Further Pricing, Availability, and Operating Systems Options, Call or Write to American Small Business Computers and ask for the CAMEO CONNECTION.



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The Corvus Disk Drive Subsystem (center of picture) Is Available in 5, 10, and 20 Million Character Capacities. The Corvus System Is The Ultimate In The Sealed "Winchester, All-Fixed" Type Drive. The Corvus Is Designed To Operate In The Harshest Environments Such As Factories, Oil Rigs, Etc. Backup Of Data Is Accomplished Via Optional MIRROR Backup Device Whereby Data Is Written Onto A Standard Video Tape Recorder. A Great Number of Model II's May Be Attached To The Corvus Via An Optional CONSTELLATION Multiplexor. For Further Pricing, Availability, and Operating Systems, Call Or Write to American Small Business Computers and Ask for the CORVUS CONNECTION.

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The MINI-5 (being held by Corporate President Robert Webster) Is American Small Business Computer's Very Own Disk Subsystem. The MINI-5 Offers Approximately 5 Million Characters of Information Storage and is Based On the Famous Seagale Technology ST-506 Micro Winchester Drive. Now You Can Own State-Of-The-Art Technology At An Affordable Price — Only $3500 — Which Includes Drive, Controller Electronics, Power Supply, Cabinet, Cables, Documentation and Operating System Software.

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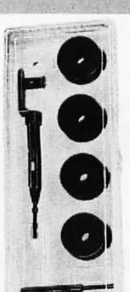
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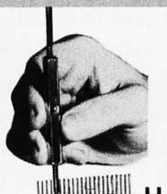


JUST WRAP KIT

Just Wrap tool for daisy chain wiring. Tool strips as it wraps and cuts. Includes one 50 foot spool of wire.

Part No.	Description	Price
JW-1*	Just Wrap Tool	$14.95
JWK-6	Tool w/4 Spools and JUW1	24.95
R-JW*	50 Ft. Replacement Wire	3.49
JUW-1	Unwrapping Tool	3.49

*Specify Color: Red, Blue, White or Yellow.





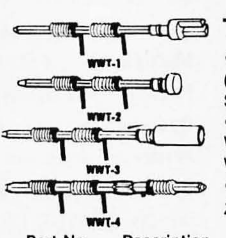
Regular Wrap



Modified Wrap

HAND WRAP TOOL

Part No.	Description	Price
WSU30	Regular	$6.95
WSU30M	Modified	7.95



TERMINALS

- .025 (0,63mm) Square Post
- 3 Level Wire-Wrapping
- Gold Plated

25 PER PKG.

Part No.	Description	Price
WWT-1	Slotted Terminal	$4.98
WWT-2	Single Sided Terminal	2.98
WWT-3	IC Socket Term.	4.98
WWT-4	Double Sided Terminal	1.98
INS 1	Insertion Tool for above	2.49

SOCKET WRAP — ID

13 14 15 16 17 18 19 20 21 22 23 24 Wrap-ID Pat. Pend 12 11 10 9 8 7 6 5 4 3 2 1

Slipped onto socket before wrapping to identify pins.

Part #	Price	Bulk Price	Part #	Price	Bulk Price
14ID	1.49/10	5.50/100	22ID	1.49/5	5.95/50
16ID	1.49/10	5.95/100	24ID	1.49/5	5.95/50
18ID	1.49/10	5.00/50	28ID	1.49/5	6.50/50
20ID	1.49/5	5.00/50	40ID	1.49/5	5.00/25

P.C.B. TERMINAL STRIPS

The TS strips provide positive screw activated clamping action, accommodate wire sizes 14-30 AWG (1,8-0, 25mm). Pins are solder plated copper, .042 inch (1mm) diameter, on .200 inch (5mm) centers.

Part No.	Description	Price
TS- 4	4-Pole	$1.69
TS- 8	8-Pole	2.59
TS-12	12-Pole	3.49
TS6MD	2-Pole Interlocking	3/1.79



DESOLDERING PUMP

Easy one hand operation. Rugged all metal construction. Replaceable TEFLON® Tip. Self cleaning on each stroke. Suction precisely regulated for reliable desoldering without damage to delicate circuitry.

DSPI	Desoldering Pump	$9.95

LOGIC PROBE



Compatible with all logic families using a 4 to 15V power supply. Thresholds automatically programmed. Visual indication of logic levels to show high, low, bad level or open circuit logic pulses.

- 10 N sec. pulse responses
- 120 K input impedence.
- Automatic resetting memory.
- Includes tip with protective cap & coiled cord.

PRB-1 $36.95

LOGIC PULSER

Superimposes a pulse train (20 pps) or a single pulse onto the circuit node under test without un-soldering IC's.

- Automatic polarity sensing
- 2 us pulse width
- Finger tip push button actuated
- Includes tip with protective cap & coiled cord.

PSL-1 $48.95

VACUUM VISE

Unique vacuum-based light duty vise for precision handling of small components and assemblies. Rugged ABS construction. 1½" (32mm) travel for maximum versatility. Also features screw lugs for permanent installation.

VV1	Vacuum Vice	$3.49



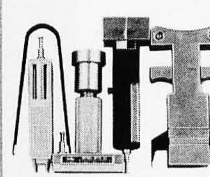
HOBBY-WRAP TOOL BW2630

- Auto-Indexing
- Anti-Overwrap
- Modified Wrap

Part No.	Description	Price
BW2630	Tool	$19.85
BT30	#30 Bit (not incl.)	3.95
BT2628	#28 Bit (not incl.)	7.95
BC1	Batteries & Charger	14.95

INSERTION/EXTRACTION TOOLS

Part No.	Description	Price
INS1416	14-16 pin Inserter	$3.49
MOS1416	14-16 pin MOS Safe Inserter	7.95
MOS2428	24-28 pin MOS Safe Inserter	7.95
MOS40	40 pin MOS Safe Inserter	7.95
EX1	14-16 pin IC Extractor	1.49
EX2	24-40 pin IC Extractor	7.95



WK-7 IC INSERTION KIT

Complete IC Inserter/ Extractor Kit Individual Components (listed above) $22.95

IC DISPENSER

Allows IC's to be dispensed from their tube 1 at a time and picked up by insertion tools above.

• Dispenses 8-42 pin IC's • Compatable with all IC carrying tubes • Use with WK7 for MOS safe insertion. •

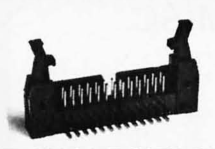
Part No.	Description	Price
MDD1	1 Chan. Dispenser	$21.85
MDD5	5 Chan. Dispenser	83.43
MDD10	10 Chan. Dispenser	160.45

* * *No Discount.



TOLL FREE ORDERING NUMBER 1-(800) 423-7144

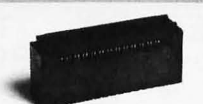
IDC CONNECTORS



RIGHT ANGLE HEADERS

	SOLDER TAIL		WIRE WRAP	
Size	Part No.	Price	Part No.	Price
10	IDH10SRB	$1.20	IDH10WRB	$2.60
20	IDH20SRB	1.90	IDH20WRB	4.15
26	IDH26SRB	2.75	IDH26WRB	5.35
34	IDH34SRB	3.75	IDH34WRB	6.25
40	IDH40SRB	3.75	IDH40WRB	7.35
50	IDH50SRB	4.75	IDH50WRB	9.20

.1" Spacing. Mounts on PC Board & Mates with IDS Socket below. Ejector Bars - 4/1.00.



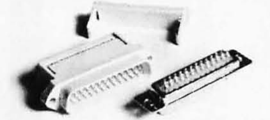
EDGE CARD CONNECTORS

Size	Part No.	Price
10	IDE10B	$3.95
20	IDE20B	4.35
26	IDE26B	5.00
34	IDE34B	6.05
40	IDE40B	6.90
50	IDE50B	7.50

.1" Spacing. Crimps onto cable with ordinary vise & mates with standard .062" Card Edge.

RIBBON CABLE

	Solid Color		Color Coded	
Size	10 ft.	100 ft.	10 ft.	100 ft.
10	2.90	17.00	4.00	30.00
14	3.40	23.80	5.00	42.00
16	3.70	27.20	5.60	48.00
20	4.40	34.00	7.00	60.00
24	5.00	40.80	8.00	72.00
26	5.40	44.20	8.60	78.00
34	6.80	57.80	11.00	102.00
40	7.80	68.00	13.00	120.00
50	9.50	85.00	16.00	150.00



25 PIN "D" CONNECTORS

Solder Style	Part No.	Price
Male	DB25P	$2.95
Female	DB25S	3.95
Cover	DB25C	1.50
IDC Style		
Male	IDB25P	6.25
Female	IDB25S	6.60
Cover	IDB25C	1.60

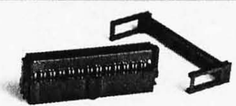
Solder Style solders onto cable, IDC Style crimps onto cable with vise. 9, 15, 37 and 50 pin available also.



CABLE PLUGS

Size	Part No.	Price
14	IDP14B	$1.45
16	IDP16B	1.65
24	IDP24B	2.50
40	IDP40B	4.15

.1" Spacing. Crimps onto cable with ordinary vise & plugs into standard IC Socket.



SOCKETS

Size	Part No.	Price
10	IDS10B	$1.88
20	IDS20B	2.75
26	IDS26B	3.50
34	IDS34B	4.50
40	IDS40B	5.40
50	IDS50B	6.50

.1" Spacing. Crimps onto cable with ordinary vise & mounts to header sold above.

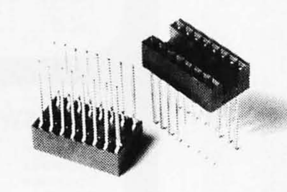
WIRE WRAP SUPPLIES

WIRE WRAP WIRE

#30 Wire Wrap Wire

Length	100/Bag	500/Bag	1K/Bag
2.5"	$1.38	$6.81	$3.94
3.0"	1.43	7.46	4.25
3.5"	1.51	8.11	4.57
4.0"	1.56	8.73	4.88
4.5"	1.63	9.39	5.21
5.0"	1.69	10.04	5.54
5.5"	1.74	10.69	5.92
6.0"	1.82	11.34	6.23
6.5"	2.11	12.99	7.08
7.0"	2.19	13.68	7.44
7.5"	2.29	14.40	7.78
8.0"	2.35	15.10	8.12
8.5"	2.40	15.80	8.46
9.0"	2.46	16.51	8.92
9.5"	2.53	17.22	9.15
10.0"	2.63	17.91	9.58

All lengths are overall, including 1" strip on each end. Choose from colors; Red, Blue, Black, Yellow, White, Green, Orange, and Violet.



Size	Part No.	Each	Tube
08	ICN083WBSG	.44	52x .39 = $20.28
14	ICN143WBSG	.53	30x .46 = $13.80
16	ICN163WBSG	.58	26x .50 = $13.00
18	ICN183WBSG	.78	23x .68 = $15.64
20	ICN203WBSG	1.00	21x .85 = $17.85
22	ICN224WBSG	1.07	19x .92 = $17.48
24	ICN246WBSG	1.09	17x1.09 = $15.98
28	ICN286WBSG	1.43	15x1.23 = $18.45
40	ICN406WBSG	1.85	10x1.60 = $16.00

Selective Plating provides gold in contact where it counts. 3-level wrap. Save by buying sockets by the tube. All gold available at ½¢/pin extra charge.

* * * No Discount

WIRE KITS

Kit No. 1 — $9.95

250	3"	100	4½"
200	3½"	100	5"
100	4"	100	6"

Kit No. 2 — $24.95

250	2½"	250	5"
500	3"	100	5½"
500	3½"	100	6"
500	4"	100	6½"
250	4½"	100	7"

Kit No. 3 — $34.95

250	2½"	500	4½"
500	3"	500	5"
500	3½"	500	5½"
500	4"	500	6"

Kit No. 4 — $59.95

500	2½"	1000	4½"
1000	3"	1000	5"
1000	3½"	1000	5½"
1000	4"	1000	6"

ORDERING INFORMATION

Prepaid orders over $50 shipped prepaid via UPS. All others add $3.00 for handling. VISA, MC, COD's and open account orders will be charged freight. $15 minimum order. $100 minimum open account order.

DISCOUNT SCHEDULE

Order	Amount
$15 - 99	Net
100 - 199	less 10%
200 - 499	less 15%
500 - 999	less 20%
1000 up	less 25%

Discount and the name of this magazine must be mentioned at time of order to get discount. Discount applies on all items except as noted, "No Discount."

16K Memory 8/$16.95

4116 300ns

ALL MERCHANDISE 100% GUARANTEED — **CALL US FOR VOLUME QUOTES**

LS SERIES

74LS00	.25	74LS163	.95
74LS01	.25	74LS164	.95
74LS02	.25	74LS165	.95
74LS03	.25	74LS166	2.40
74LS04	.25	74LS168	1.75
74LS05	.25	74LS169	1.75
74LS08	.35	74LS170	1.75
74LS09	.25	74LS173	.80
74LS10	.25	74LS174	.95
74LS11	.35	74LS175	.95
74LS12	.35	74LS181	2.15
74LS13	.45	74LS189	9.95
74LS14	1.00	74LS190	1.00
74LS15	.35	74LS191	1.00
74LS20	.25	74LS192	.85
74LS21	.35	74LS193	.95
74LS22	.25	74LS194	1.00
74LS26	.35	74LS195	.95
74LS27	.35	74LS196	.85
74LS28	.35	74LS197	.85
74LS30	.25	74LS221	1.20
74LS32	.35	74LS240	1.85
74LS33	.55	74LS241	1.85
74LS37	.55	74LS242	1.85
74LS38	.35	74LS243	1.85
74LS40	.25	74LS244	1.75
74LS42	.55	74LS245	2.85
74LS47	.75	74LS247	.76
74LS48	.75	74LS248	1.25
74LS49	.75	74LS249	.99
74LS51	.25	74LS251	1.30
74LS54	.35	74LS253	.85
74LS55	.35	74LS257	.85
74LS63	1.25	74LS258	.85
74LS73	.40	74LS259	2.85
74LS74	.45	74LS260	.65
74LS75	.50	74LS266	.55
74LS76	.40	74LS273	1.65
74LS78	.50	74LS275	3.35
74LS83	.75	74LS279	.55
74LS85	1.15	74LS280	1.98
74LS86	.40	74LS283	1.00
74LS90	.65	74LS290	1.25
74LS91	.89	74LS293	1.85
74LS92	.70	74LS295	1.05
74LS93	.65	74LS298	1.20
74LS95	.85	74LS352	1.55
74LS96	.95	74LS353	1.55
74LS107	.40	74LS363	1.35
74LS109	.40	74LS365	.95
74LS112	.45	74LS366	.95
74LS113	.45	74LS367	.70
74LS114	.50	74LS368	.70
74LS122	.45	74LS373	1.85
74LS123	.95	74LS374	1.80
74LS124	2.99	74LS377	1.45
74LS125	.95	74LS378	1.18
74LS126	.85	74LS379	1.35
74LS132	.75	74LS385	1.90
74LS136	.55	74LS386	.65
74LS137	.99	74LS390	1.90
74LS138	.75	74LS393	1.90
74LS139	.75	74LS395	1.65
74LS145	1.20	74LS399	1.70
74LS147	2.49	74LS447	.37
74LS148	1.35	74LS490	1.95
74LS151	.75	74LS668	1.69
74LS153	.75	74LS669	1.89
74LS154	2.35	74LS670	2.20
74LS155	1.15	74LS674	9.65
74LS156	.95	74LS682	3.20
74LS157	.75	74LS683	2.30
74LS158	.75	74LS684	2.40
74LS160	.90	74LS685	2.40
74LS161	.95	74LS688	2.40
74LS162	.95	74LS689	2.40

7400 SERIES

7400	.19	74128	.55
7401	.19	74132	.45
7402	.19	74136	.50
7403	.19	74141	.65
7404	.19	74142	2.95
7405	.22	74143	2.95
7406	.22	74144	2.95
7407	.22	74145	.60
7408	.24	74147	1.75
7409	.19	74148	1.20
7410	.19	74150	1.35
7411	.25	74151	.65
7412	.30	74152	.65
7413	.35	74153	.55
7414	.55	74154	1.40
7416	.25	74155	.75
7417	.25	74156	.65
7420	.19	74157	.55
7421	.35	74159	1.65
7422	.29	74160	.85
7423	.29	74161	.70
7425	.29	74162	.85
7426	.29	74163	.85
7427	.29	74164	.85
7428	.45	74165	.85
7430	.19	74166	1.00
7432	.29	74167	1.95
7433	.45	74170	1.65
7437	.29	74172	5.95
7438	.29	74173	.75
7440	.19	74174	.89
7442	.49	74175	.89
7443	.65	74176	.89
7444	.69	74177	.75
7445	.69	74178	1.15
7446	.59	74179	1.75
7447	.69	74180	.75
7448	.69	74181	2.25
7450	.19	74182	.75
7451	.23	74184	2.00
7453	.23	74185	2.00
7454	.23	74186	18.50
7460	.23	74190	1.15
7464	.39	74191	1.15
7465	.39	74192	.79
7470	.35	74193	.79
7472	.29	74194	.85
7473	.34	74195	.85
7474	.35	74196	.79
7475	.49	74197	.75
7476	.35	74198	1.35
7480	.59	74199	1.35
7481	1.10	74221	1.35
7482	.95	74246	1.35
7483	.50	74247	1.25
7484	.50	74248	1.85
7485	.65	74249	1.95
7486	.35	74251	.75
7489	4.95	74259	2.25
7490	.35	74265	1.35
7491	.40	74273	1.95
7492	.50	74276	1.25
7493	.49	74279	.75
7494	.65	74283	2.00
7495	.55	74284	3.75
7496	.70	74285	3.75
7497	2.75	74290	.95
74100	1.00	74293	.75
74107	.30	74298	.85
74109	.45	74351	2.25
74110	.45	74365	.65
74111	.55	74366	.65
74116	1.55	74367	.65
74120	1.20	74368	.65
74121	.29	74376	2.20
74122	.45	74390	1.75
74123	.55	74393	1.35
74125	.45	74425	3.15
74126	.45	74426	.85
		74490	2.55

T.V. CIRCUITS

MC1330	1.89
MC1350	1.29
MC1358	1.79
LM380	1.29
LM386	1.50
LM565	.99
LM741	.29
LM1310	2.90
LM1800	2.99
LM1889	2.49

MISC.

8T26	1.69	3242	9.95
8T28	2.49	AY5-1013	3.95
8T95	.99	TR1602	4.95
8T96	.99	IM6402	7.95
8T97	.99	1771	24.95
8T98	.99	1791	36.95
1488	.99	UPD765	39.95
1489	.99	8272	39.95
DM8131	2.95		

CMOS

74C00	.35	74C373	2.75	4018	.95	4093	.95
74C02	.35	74C374	2.75	4019	.45	4099	1.95
74C04	.35	74C901	.80	4020	.95	14409	8.95
74C08	.35	74C902	.85	4021	.95	14410	8.95
74C10	.35	74C903	.85	4022	1.15	14411	9.95
74C14	1.50	74C905	10.95	4023	.35	14412	12.95
74C20	.35	74C906	.95	4024	.75	14419	2.95
74C30	.35	74C907	1.00	4025	.35	4502	.95
74C32	.50	74C908	2.00	4026	1.65	4503	.65
74C42	1.75	74C909	2.75	4027	.65	4508	1.95
74C48	2.10	74C910	9.95	4028	.80	4510	.95
74C73	.65	74C911	10.00	4029	.95	4511	.95
74C74	.85	74C912	10.00	4030	.45	4512	.95
74C76	.80	74C914	1.95	4034	2.95	4514	1.25
74C83	1.95	74C915	2.00	4035	.85	4515	2.25
74C85	1.95	74C918	2.75	4040	.95	4516	1.55
74C86	.95	74C920	17.95	4041	1.25	4518	1.25
74C89	4.50	74C921	15.95	4042	.75	4519	1.25
74C90	1.75	74C922	5.95	4043	.85	4520	1.25
74C93	1.75	74C923	5.95	4044	.85	4522	1.25
74C95	1.75	74C925	6.75	4046	.95	4526	1.25
74C107	1.00	74C926	7.95	4047	.95	4527	1.95
74C150	5.75	74C927	7.95	4049	.55	4528	1.25
74C151	2.25	74C928	7.95	4050	.55	4531	.95
74C154	3.25	74C929	19.95	4051	.95	4532	1.95
74C157	1.75	74C930	19.95	4053	.95	4538	1.95
74C160	2.00	4000	.35	4060	1.45	4539	1.95
74C161	2.00	4001	.35	4066	.75	4543	2.70
74C162	2.00	4002	.25	4068	.40	4555	.95
74C163	2.00	4006	.95	4069	.35	4556	.95
74C164	2.00	4007	.29	4070	.35	4581	1.95
74C165	2.00	4008	.95	4071	.30	4582	1.95
74C173	2.00	4009	.45	4072	.30	4584	.95
74C174	2.25	4010	.45	4073	.30	4585	.95
74C175	2.25	4011	.35	4075	.30	4702	12.95
74C192	2.25	4012	.25	4076	.95	4724	1.50
74C193	2.25	4013	.45	4078	.30	80C07	.95
74C195	2.25	4014	.95	4081	.30	80C95	.85
74C200	5.75	4015	.95	4082	.30	80C96	.95
74C221	2.25	4016	.45	4085	.95	80C97	.95
		4017	1.15	4086	.95	80C98	1.20

DIP SWITCHES

4 position	.85
5 position	.90
6 position	.90
7 position	.95
8 position	.95

CONNECTORS

RS232 MALE	3.25
RS232 FEMALE	3.75
RS232 HOOD	1.25
S-100 ST	3.95
S-100 WW	4.95

TRANSISTORS

PN2222	10/1.00	100/8.99
2N3904	10/1.00	100/8.99
2N3906	10/1.00	100/8.99
2N3055	.79	10/6.99
IN4148		25/1.00
IN4004		10/1.00

LINEAR

LM301V	.34	LM741V	.29
LM308V	.98	LM747	.79
LM309K	1.49	LM748V	.59
LM311	.64	LM1310	2.90
LM317T	1.95	MC1330	1.89
LM317K	3.95	MC1350	1.29
LM318	1.49	MC1358	1.79
LM323K	4.95	LM1414	1.59
LM324	.59	LM1458V	.69
LM337K	3.95	LM1488	1.39
LM339	.99	LM1489	1.39
LM377	2.29	LM1800	2.99
LM380	1.29	LM1889	2.49
LM386V	1.50	LM3900	.59
LM555V	.39	LM3909V	.98
LM556	.69	LM3914	3.95
LM565	.99	LM3915	3.95
LM566V	1.49	LM3916	3.95
LM567V	1.29	75451V	.39
LM723	.49	75452V	.39
LM733	.98	75453V	.39

T=TO-220 V=8 PIN K=TO-3

74S00 SERIES

74S00	.44	74S74	.69	74S163	3.75	74S258	1.49
74S02	.48	74S85	2.39	74S168	4.65	74S260	1.83
74S03	.48	74S86	1.44	74S169	5.44	74S274	19.95
74S04	.79	74S112	1.59	74S174	1.09	74S275	19.95
74S05	.79	74S113	1.98	74S175	1.09	74S280	2.90
74S08	.48	74S114	1.50	74S181	4.47	74S287	4.75
74S09	.98	74S124	2.77	74S182	2.95	74S288	4.45
74S10	.69	74S132	1.24	74S188	3.95	74S289	6.98
74S11	.88	74S133	.98	74S189	14.95	74S301	6.95
74S15	.70	74S134	.69	74S194	2.95	74S373	3.45
74S20	.68	74S135	1.48	74S195	1.89	74S374	3.45
74S22	.98	74S138	1.08	74S196	4.90	74S381	7.95
74S30	.48	74S139	1.25	74S197	4.25	74S387	5.75
74S32	.98	74S140	1.45	74S201	14.95	74S412	2.98
74S37	1.87	74S151	1.19	74S225	8.95	74S471	9.95
74S38	1.68	74S153	1.19	74S240	3.98	74S472	16.85
74S40	.44	74S157	1.19	74S241	3.75	74S474	17.85
74S51	.78	74S158	1.45	74S251	1.90	74S482	15.60
74S64	.79	74S161	2.85	74S253	7.45	74S570	7.80
74S65	1.25	74S162	3.70	74S257	1.39	74S571	7.80

VOLTAGE REG'S

7805T	.89	7905T	.99
7808T	.99	7912T	.99
7812T	.89	7915T	1.19
7815T	.99	7924T	1.19
7824T	.99		
7805K	1.39	7905K	1.49
7812K	1.39	7912K	1.49
7815K	1.39		
78L05	.69	79L05	.79
78L12	.69	79L12	.79
78L15	.69	79L15	.79
LM309K	1.49	LM323K	4.95
LM317T	1.95	LM337K	3.95
LM317K	3.95		

T = TO-220 K = TO-3 L = TO-92





JDR MICRODEVICES, INC.
1101 South Winchester Blvd.
San Jose, California 95128
800-538-5000 800-662-6263 (Calif.)
408-247-4852

TERMS: For shipping include $2.00 for UPS Ground; $3.00 for UPS Blue Label Air; $10.00 minimum order. Bay Area Residents add 6½% sales tax Calif. Residents add 6% sales tax. We reserve the right to limit quantities and substitute manufacturer. Prices subject to change without notice.

Circle 184 on inquiry card.

4K STATIC RAMS 8/18.95

2114 LOW POWER 450ns

ALL MERCHANDISE 100% GUARANTEED — CALL US FOR VOLUME QUOTES

8200

8202	45.00
8205	3.50
8212	1.95
8214	3.90
8216	1.85
8224	2.50
8226	1.85
8228	4.95
8237	19.95
8238	4.95
8243	4.50
8250	14.95
8251	5.50
8253	9.85
8253-5	9.85
8255	5.25
8255-5	5.25
8257	9.00
8259	7.00
8272	39.95
8275	29.95
8279	10.50
8279-5	10.50
8282	6.65
8283	6.65
8284	5.80
8286	6.65
8287	6.65
8288	25.00
8289	49.95

6800

6800	6.95
6802	11.95
6809	37.95
6810	4.60
6820	4.95
6821	4.95
6828	9.95
6834	16.95
6840	14.95
6843	42.95
6844	44.95
6845	29.95
6847	15.95
6850	4.75
6852	5.75
6860	10.95
6862	11.95
6871	25.95
6875	6.95
6880	2.95

Z80

Z80	8.95
Z80A	9.95
Z80B	19.95
Z80-PIO	6.50
Z80A-PIO	8.60
Z80-CTC	6.50
Z80A-CTC	8.65
Z80-DART	15.25
Z80A-DART	18.75
Z80-DMA	17.50
Z80A-DMA	27.50
Z80-SIO/0	23.95
Z80A-SIO/0	28.95
Z80-SIO/1	23.95
Z80A-SIO/1	28.95
Z80-SIO/2	23.95
Z80A-SIO/2	28.95
Z80-SIO/9	17.95
Z80A-SIO/9	22.95

6502

6502	6.95
6502A	12.95
6504	6.95
6505	8.95
6520	4.95
6522	9.95
6532	14.95
6551	14.95

MPU'S

8035	16.95
8039	19.95
8080A	3.95
8085	12.95
8086	99.95
8088	39.95
8155	11.95
8156	11.95
8185	29.95
8185-2	39.95
8741	39.95
8748	69.95
8755	49.95

IC SOCKETS

	1-100	100pcs
8 pin ST	.13	.11
14 pin ST	.15	.12
16 pin ST	.17	.13
18 pin ST	.20	.18
20 pin ST	.29	.27
22 pin ST	.30	.27
24 pin ST	.30	.27
28 pin ST	.40	.32
40 pin ST	.49	.39

ST = SOLDERTAIL

8 pin WW	.59	.49
14 pin WW	.69	.52
16 pin WW	.69	.58
18 pin WW	.99	.90
20 pin WW	1.09	.98
22 pin WW	1.39	1.28
24 pin WW	1.49	1.35
28 pin WW	1.69	1.49
40 pin WW	1.99	1.80

WW = WIREWRAP

BEFORE YOU BUY CALL JDR FOR THE BEST PRICE.

800-538-5000

800-662-6233

(CALIFORNIA RESIDENTS)

APPLE OWNERS

EXPAND YOUR 48K COMPUTER TO 64K

SUPER RAM•II

- PLUG IN SLOT ϕ
- GOLD PLATED CONTACTS
- INCLUDES 5 JUMPER OPTIONS
- INCLUDES 5 RAM-ROM OPTIONS
- ENJOY THE BEST OF BOTH WORLDS
- 16K RAM (RANDOM ACCESS MEMORY)
- THIS IS SOPHISTICATED FIRMWARE
- EXPANDS YOUR 48K APPLE TO 64K OF PROGRAMMABLE MEMORY



- ELIMINATES THE NEED FOR APPLESOFT* OR INTEGER BASIC ROM CARD
- ALLOWS YOU TO RUN APPLE'S NEW FORTRAN PACKAGE ALSO PASCAL AND PILOT
- KEYBOARD CONTROL SELECTION OF RAM OR MOTHER BOARD ROM LANGUAGE
- INCLUDES: INSTALLATION INSTRUCTIONS AND APPLICATIONS NOTES
- THE SOFTWARE DEVELOPED BY VARIOUS VENDORS FOR YOUR (64K) SHOULD NOW WORK AS THEY ADVERTISED
- THE MOST VERSATILE RAM EXPANSION ON THE MARKET TODAY

UNIQUE 1 YEAR WARRANTEE!! $168.00

SUPER FAN II

"COOL-IT"

- TAN COLOR
- SAVE DOWN TIME
- LONG LIFE MOTOR
- LOW NOISE IS A MUST
- SAVE REPAIR CHARGES
- INCREASES RELIABILITY
- CLIPS ON—NO HOLES OR SCREWS
- MINIMUM QUIETNESS IS DUE TO THE DRAW EFFECT OF AIR THROUGH YOUR COMPUTER AND A SPECIAL FAN AND MOTOR DESIGN
- THOSE EXTRA PLUG-IN CARDS CAN CAUSE EXTRA HEAT

HOW TO HOOK IT UP

1. Clip it on your APPLE
2. Unplug your 120V cable (you won't need it)
3. Plug short 120V cable from Super Fan II to the back of your computer
4. Plug the supply cable from Super Fan II to your 120V power source
5. Turn on the rocker switch and a built-in red ready light comes on
6. You are all set *"COOL IT"*

UNIQUE 1 YEAR WARRANTEE!! $69.00

*APPLE IS A TRADEMARK OF APPLE COMPUTER INC.

LEDS

Jumbo Red	10/1.00
Jumbo Green	6/1.00
Jumbo Yellow	6/1.00
5082-7760 .43'CC	.79
MAN74 .3'CC	.99
MAN72 .3'CA	.99

DYNAMIC RAMS

			100pcs
4027	(250ns)	2.50	2.00
4116-150	(150ns)	8/21.95	2.65
4116-200	(200ns)	8/19.95	2.35
4116-300	(300ns)	8/16.95	2.00
4164	(200ns)	CALL	CALL

EPROMS

					8pcs
1702		256 × 8	(1us)	4.95	4.50
2708		1024 × 8	(450ns)	3.95	3.50
2716	(5v)	2048 × 8	(450ns)	6.95	5.95
2758	(5v)	1024 × 8	(450ns)	9.95	8.95
2716-1	(5v)	2048 × 8	(350ns)	12.95	11.95
TMS2716		2048 × 8	(450ns)	9.95	8.95
TMS2532	(5v)	4096 × 8	(450ns)	21.95	19.95
2732	(5v)	4096 × 8	(450ns)	17.95	16.95

STATIC RAMS

			100pcs
2101	(450ns)	1.95	1.85
2102-1	(450ns)	.89	.85
21L02-1	(LP) (450ns)	1.29	1.15
2111	(450ns)	2.99	2.49
2112	(450ns)	2.99	2.79
2114	(450ns)	8/18.95	2.25
2114L-2	(LP) (200ns)	8/22.95	2.45
2114L-3	(300ns)	8/21.95	2.45
2113L-4	(LP) (450ns)	8/18.95	2.25
4044-4	(450ns)	3.49	3.25
4044-3	(300ns)	3.99	3.75
TMM2016	(200ns)	CALL	CALL
MB6116	(200ns)	CALL	CALL

LP = LOW POWER

PROMS

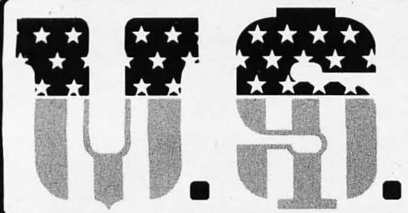
74S188	(82S23)	OC	32 × 8	3.95
74S287	(82S129)	TS	256 × 4	4.75
74S288	(82S123)	TS	32 × 8	4.45
74S387	(82S126)	OC	256 × 4	5.75
74S471		TS	256 × 8	9.95
74S472	(82S147)	TS	512 × 8	16.85
74S474	(82S141)	TS	512 × 8	17.85
74S570	(82S130)	OC	512 × 4	7.80
74S571	(82S131)	TS	512 × 4	7.80



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MICRO SALES

DEALS □ DEALS □ DEALS

SHOP HERE AND

SAVE!

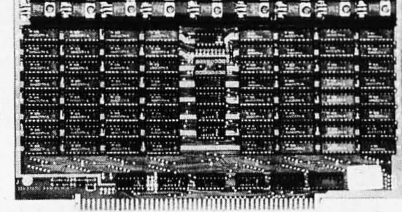
(MINIMUM ORDER $10.00)

This is ABSOLUTELY the LOWEST PRICE EVER for a Hi Speed (300 NS) LO-LO Power 32K RAM. 4K by 1 Chips are organized in Selectable Banks.

- *Extended Address Lines A16 - A17*
- *Phantom Line*
- *9 Regulators*



(KIT)



SCHOOLS

DIP SWITCHES

POS.	PRC.
4	.88
5	.92
6	.95
7	.99
8	1.05
9	1.15
10	1.19

AMP - Need we say more? There is a difference in sockets! These aren't the lowest prices you can find. But, if you've been "burned" before by bad connections in your computer, a few pennies for the best is worth it!

PINS	PC	WW
8	.10	.26
14	.13	.29
16	.16	.32
18	.18	.34
20	.22	.38
24	.32	.48
28	.34	.50
40	.45	.61

RESISTORS .02 ea!

(100 PACK) ¼W

1.0	75	2.7K	22K	220K
4.7	100	3.3K	24K	330K
6.8	150	3.9K	27K	470K
10	220	4.7K	33K	680K
15	330	6.8K	39K	1M
22	470	10K	47K	1.5M
27	680	12K	68K	2.2M
33	1K	15K	100K	4.7M
47	1.5K	18K	150K	10M
68	2.2K	20K		

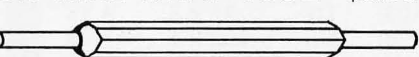
WIRE WRAP WIRE

Packed in 500 Lot Bundles
(Length includes 2" x 1" Strip)
Color — R, Bu, G, Y, Bk, W

50 ft. $1.65 - 100 ft. $3.00 - 500 ft. $9.50

2.5–3.25	4.0–3.75	6.0–4.75
3.0–3.35	4.5–4.00	7.0–5.00
3.5–3.50	5.0–4.50	8.0–5.50
		10.0–6.50

OK WIRE WRAP TOOL $5.95

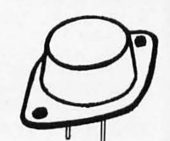


COMPUTER GRADE ELECTROLYTICS

Capac.	Volt	Type	$
150,000	15	CAN	12.50
18,000	25	CAN	5.50
6,000	50	CAN	5.75
10,000	16	AXIAL	4.95
4.700	35	AXIAL	3.50

HOBBIEST

LM323K



5V. 3A. REGULATOR

$5.50

TAB MOUNT

7805	+5V 1A
7905	–5V 1A
7812	+12V 1A
7912	–12V 1A

HEAT SINKS 49¢

$1.25

♦ GOLD ♦ S-100-CONNECTOR

TI or Better



SOLDER TAIL	WIRE WRAP
$2.50	**$3.25**

DIP PLUGS

PART#	PINS	PRICE
08DP	8	.40
14DP	14	.55
16DP	16	.58
24DP	24	.95
40DP	40	1.50

Socket and Dip Plug priced based on gold not exceeding $700 per ounce.

CONNECTORS

DUAL ROW .100 PINS	PRICE	CARD EDGE PINS	PRICE
20	2.35	20	3.35
26	3.00	26	3.80
34	3.85	34	4.65
40	4.50	40	5.50
50	5.50	50	5.90

RIBBON — 20 to 34 @ 1.00 ft.
40 & 50 @ 1.30 ft.

CRIMPING 2.00 / CONNECTOR

OEM'S

Z-80-A

$6.95

4MHZ Beastie with extra instructions!

Z-80 SUPPORT

CTC — $6.55
SIO — $25.50
PIO — $6.50
DMA — $18.75

All 4MHZ (who wants 2MHZ?)

74LSXX

74LS00	.33	74LS107	.59	74LS221	2.95
74LS01	.33	74LS109	.59	74LS240	2.95
74LS02	.33	74LS112	.59	74LS241	2.49
74LS03	.33	74LS113	.59	74LS242	1.95
74LS04	.59	74LS114	.49	74LS243	1.95
74LS05	.39	74LS122	.59	74LS244	2.95
74LS06	.39	74LS123	1.19	74LS245	8.95
74LS07	.39	74LS124	1.49	74LS247	1.19
74LS08	.59	74LS125	.89	74LS248	1.19
74LS09	.39	74LS126	.89	74LS249	1.69
74LS10	.29	74LS132	.79	74LS251	1.79
74LS11	.39	74LS133	1.19	74LS253	.95
74LS12	.39	74LS136	.69	74LS257	1.95
74LS13	.69	74LS138	.99	74LS258	1.95
74LS14	1.25	74LS139	.99	74LS259	2.95
74LS15	.49	74LS145	1.25	74LS260	.75
74LS20	1.95	74LS148	1.49	74LS266	1.15
74LS21	3.7	74LS151	.79	74LS273	1.75
74LS22	.29	74LS154	2.49	74LS275	4.39
74LS26	.39	74LS155	1.49	74LS279	.79
74LS27	.49	74LS156	1.49	74LS283	1.49
74LS28	.39	74LS157	1.49	74LS289	5.75
74LS30	.49	74LS158	1.49	74LS290	1.29
74LS32	.95	74LS160	.75	74LS293	1.95
74LS33	1.95	74LS161	1.99	74LS295	1.95
74LS37	.75	74LS162	1.25	74LS298	1.29
74LS38	.39	74LS163	1.25	74LS324	1.75
74LS40	.25	74LS164	2.15	74LS352	1.65
74LS42	1.39	74LS165	1.49	74LS353	1.65
74LS47	.79	74LS166	2.49	74LS365	.95
74LS48	.79	74LS168	2.95	74LS366	.79
74LS35	.25	74LS169	1.95	74LS367	.99
74LS54	.25	74LS170	1.95	74LS368	.99
74LS55	.70	74LS173	1.25	74LS373	2.95
74LS73	.79	74LS174	1.49	74LS374	3.95
74LS74	.59	74LS175	1.49	74LS377	1.95
74LS75	.79	74LS181	2.15	74LS378	1.95
74LS76	.79	74LS189	6.95	74LS379	1.95
74LS78	.49	74LS190	.99	74LS386	.59
74LS83	.95	74LS191	1.95	74LS390	1.95
74LS85	1.49	74LS192	1.95	74LS393	1.95
74LS86	.95	74LS193	1.95	74LS395	1.95
74LS90	.75	74LS194	1.49	74LS490	4.95
74LS92	.75	74LS195	.95	74LS668	1.69
74LS93	.95	74LS196	.95	74LS669	1.89
74LS95	1.29	74LS197	1.95	74LS670	3.55
74LS96	1.29				

Circle 390 on inquiry card.

DEALS □ DEALS □ DEALS

OUR BUYERS ARE IN CONTACT WITH EVERY MAJOR SUPPLIER AND O.E.M. BUY HERE AT 1000 PIECE

QUANTITY PRICES

ALL MERCHANDISE 100% GUARANTEED! 15 DAY FULL CASH REFUND!



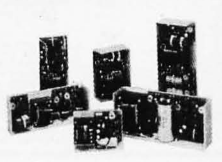
MICRO SALES

11 EDISON DRIVE ★ NEW LENOX ★ ILLINOIS 60451
CALL TOLL FREE: 1-800-435-9357 ★ MONDAY thru SATURDAY
(ILLINOIS RESIDENTS CALL: 815-485-4002) ★ 8:00 a.m. to 6:30 p.m.

TERMS: Prepayment – C.O.D. up to $100.00 – M/C Visa
$5.00 Processing and Handling added to each order PLUS Shipping Charges. Please allow personal check to clear before shipment.

JUST HOT STUFF

POWER SUPPLIES



If you can beat these prices we will be truly amazed. OEM's at 500 lot pay more than this. Call or write for full spec. sheets.

DISK POWER SUPPLIES				
PRIAM–SHUGART–CENTURY–MICROPOLIS				
+5V @ 9A	–5V @ .8A	+24V @ 7A	US-384	89.00
SHUGART – SIEMANS – MPI 5¼"				
+5V @ .5A	+12V @ .9A		US-340	33.50
+5V @ 2A	+12V @ 4A		US-323	56.25
SHUGART – SIEMANS – CDC 8"				
+5V @ 1A	–5V @ .5A	+24V @ 1.5A	US-205	52.50
+5V @ 2A	–5V @ .5A	+24V @ 3A	US-206	69.00
+5V @ 3A	–5V @ .6A	+24V @ 5A	US-162	89.00
+5V @ 1.7A	–5V @ 1.5A	+24V @ 2A	US-272	69.00
+5V @ 2A	+12V @ .4A	–12V @ .4A	US-HTAA	37.50

TELEVIDEO 950

Televideo 950 –$950.00
Televideo 912C– 665.00
Televideo 920C– 720.00
ADDS R-25 – 710.00



Also have 920C, SOROC, HAZELTINE, etc. What we don't have is room on this page. Call Toll Free 800 number for prices.

C-ITOH PRINTER

$499.00

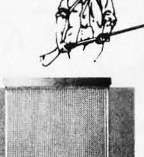


Look closely at the photo and see other adds in this rag at $995.00. Perfect units, warranteed. Only 500 pcs. Same story, manufacturerer had too many.

S-100 CARD EXTENDER

$12.50

(Gold Contacts)



As long as there is a price war, we will fight your battle. Compare at your local Dept. store and buy U$ MICRO.

MEMOREX – VERBATUM – WABASH

BASF FLOPPIES

BOX OF 10 ONLY:

5¼"	SOFT	$2.65 ea.
5¼"	HARD 10	2.65 ea.
5¼"	HARD 16	2.65 ea.
8"	SOFT 1D	3.25 ea.
8"	SOFT 2D	3.85 ea.
8"	SOFT 2DDS	5.00 ea.

SPECIAL OF THE QUARTER

S1-MOD (KIT)

$189.00 MADE IN USA



Complete S-100 12 Slot Computer. Ample system power with regulated power for drives. Excellent for Subsystem or Hobby use. 4 hours to build. (6 conn. incl., less fans)

DUAL DRIVE SUBSYSTEM

$995.00

$195.00 w/no Drives



If this looks like a Lobo Drive System, don't be fooled. Just because it looks like one, works like one, smells like one, and tastes like one (?) doesn't mean it has to cost like one!

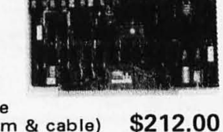
2 SHUGART 801R POWER SUPPLY

TWIN VERTICAL DRIVE$

5" $550.00 – 8" $980.00

Attractive, convenient and compact Two Drive Mass Storage includes Power Supply, Drives, Cabinets and Cables. Double Sided, Double Track available too! **$145.00 Kit (Less Cable)**

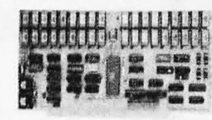
Z-80 CPU (KIT)



The first time this world popular CPU offered in Kit. 2 serial, 3 parallel, CTC, EProm Z-80 at 4 mhz. Software buad rate, etc. (less Prom & cable) **$212.00**

EXPANDABLE RAM

★SPECIAL★SPECIAL★SPECIAL★



This is the best all around 64K board you can buy. If after you see it, you don't agree return for full refund. Bank Select by extended address lines or I.O. 40H.

★$389.00 A&T★

U$ – D$K $255.00



Double Density 8" and 5" Disk Controller disigned for S-100 IEEE standards. Uses Western Digital 1795, 1691 2143 Chip Set.

FANS $14.95



3-1/8" 4-5/8"

These are brand new, in the box fans. Not noisey bearing pullouts. Never again at these low prices!

SPECIALS OF THE MONTH

4116s

$2.95

Expansion 16K Dynamic RAMs for Apple, TRS-80 S-100 systems. T.I., Mostek Intel, Call for manufacturer.

200 NS

INTEL

8251 $4.95
8255 $6.50

VERY POPULAR I.O. CHIPS BY LEADING MANUFACTURER

2114s

$3.25

One of the world's two most popular STATIC RAMs. Factory prime tested units. Sold in lots of 8 only. FUJITSU, HITACHI, etc.

200 NS

TMS-4044 MM-5257 INTEL 2147

$4.25

250 NS

CMOS Version $4.50!

The other of the world's most popular STATIC RAMs. This one is 4K by 1 organization. Don't buy Gold, buy these, the price won't last!

2716s $7.50 (450 NS)
2708s $6.95 (450 NS)

Remember when 2716s were $50.00 and hard to get? These units are so beautiful it's hard to part with them. But we will, for a small price. Guaranteed!

SHUGART DRIVE



8" 801R
$395.00

Manufacturer had too many, buys at 1000 piece rate, sales dropped, so we got'em. Fantastic buy, get them while they last! Full warranty.

8" 851R $585.00

SIEMANS DRIVE

8" 100-8

$375.00

Very Special Price on these BRAND NEW current production units
Add $10.00 for Extended 1 Year Warrantee!

Circle 390 on inquiry card.

7400

SN7400N	.19	SN74123N	.59
SN7401N	.22	SN74125N	.39
SN7402N	.22	SN74126N	.44
SN7403N	.22	SN74128N	.59
SN7404N	.22	SN74132N	.69
SN7405N	.23	SN74136N	.75
SN7406N	.23	SN74139N	.95
SN7407N	.23	SN74141N	.79
SN7408N	.26	SN74142N	2.95
SN7409N	.23	SN74143N	2.95
SN7410N	.22	SN74144N	2.95
SN7411N	.29	SN74145N	.62
SN7412N	.29	SN74147N	1.95
SN7413N	.39	SN74148N	1.20
SN7414N	.59	SN74150N	1.09
SN7416N	.29	SN74151N	.67
SN7417N	.29	SN74152N	.67
SN7420N	.22	SN74153N	.67
SN7421N	.35	SN74154N	1.19
SN7422N	.29	SN74155N	.78
SN7423N	.29	SN74156N	.78
SN7425N	.29	SN74157N	.69
SN7426N	.29	SN74158N	1.65
SN7427N	.25	SN74160N	.88
SN7429N	.45	SN74161N	.88
SN7430N	.23	SN74162N	.89
SN7432N	.29	SN74163N	.87
SN7437N	.25	SN74164N	.87
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SN7439N	.29	SN74166N	1.20
SN7440N	.19	SN74167N	1.95
SN7441N	.79	SN74170N	1.69
SN7442N	.57	SN74172N	4.75
SN7443N	.95	SN74173N	.79
SN7444N	.95	SN74174N	.89
SN7445N	.79	SN74175N	.85
SN7446N	.79	SN74176N	.75
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SN7475N	.38	SN74193N	.85
SN7476N	.34	SN74194N	.85
SN7479N	4.60	SN74195N	.68
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SN7483N	.55	SN74198N	1.39
SN7485N	.65	SN74199N	1.39
SN7486N	.35	SN74221N	1.19
SN7489N	1.75	SN74251N	.95
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74LS10N	.28	74LS175N	.89
74LS11N	.39	74LS181N	2.20
74LS12N	.33	74LS190N	1.15
74LS13N	.47	74LS191N	1.15
74LS14N	.95	74LS192N	.98
74LS15N	.33	74LS193N	.98
74LS20N	.26	74LS194N	1.15
74LS21N	.33	74LS195N	.95
74LS22N	.33	74LS196N	.89
74LS26N	.33	74LS197N	.89
74LS27N	.33	74LS221N	1.15
74LS28N	.33	74LS240N	1.69
74LS30N	.26	74LS241N	1.69
74LS32N	.33	74LS242N	1.69
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74LS112N	.43	74LS352N	1.19
74LS113N	.43	74LS353N	1.19
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74LS122N	.55	74LS365N	.69
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74LS125N	.89	74LS368N	.69
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74LS158N	.75	81LS95N	1.69
74LS160N	1.05	81LS96N	1.69
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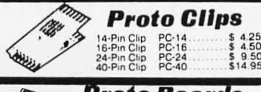
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THE VISTA V-1000 FLOPPY DISK DRIVE SUBSYSTEM ● Deluxe chassis with internal slide easy access for drive positioning and mounting ● Built to mechanically and electrically accomodate single sided drives—including the most popular 8-inch Winchester and Shugart floppy disk drives, and 8-inch streaming tape units ● Storage capacity from 0.5 to 40 megabytes ● Industrial quality cabinet with die cast front bezel ● Meets all UL and OSHA standards ● Additional Savings! Front and rear retma rail mounts provided at no extra charge (no external slides) ● Desk or rack mountable ● Features modular construction with removeable sub-assembly that allows easy cabinet positioning and mounting ● Drives pull out for easy service and maintenance.

DISCOUNT PRICES

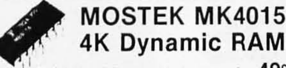
- CABINET .... $ 395
- CABINET with (2) single sided drives (Including power supply & cable) $1495
- CABINET with (2) double sided drives (including power supply & cable) $1995

Vista V-80 5¼" DISK

TRS 80® MODEL I, PMC 80, ZENITH H89, S-100, etc.
ONLY 310.00 ea.
MODEL V-801, 80 TRACKS, SS
ONLY 425.00 ea.

2 DRIVE CABLE .. 29.95 4 DRIVE CABLE .. 39.95

MOSTEK MK4015 4K Dynamic RAM



Refresh while supply lasts only .49¢
Pin equivalent to MK4027 except has 1 ms.

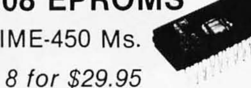
S-100 WW



$2.99 each

FIRST QUALITY AT SURPLUS PRICE

2708 EPROMS



PRIME-450 Ms.

8 for $29.95

4K STATIC RAM SELL-OFF



Zilog 6104-4

Same as TMS 4044 but designed specifically for Z-80 based systems. This is full-spec 4K × 1 RAM, 450 Ms.

While supply lasts $1.49 each.

SPECIAL PURCHASE

$59.95 Limited Supply $59.95
16K Altair RAM Boards. Fully Populated as is.

FLOPPY DISK DRIVES

QUME* Datatrack 8
- Double Sided
- Double Density

ACP LOW PRICE $569.95

- Tandom TM100-1 5¼" Disk Drive 249.95
- MPI B51-5¼", 40 tracks 239.95
- Shugart SA400-5¼" 35 tracks 295.00
- Shugart 800/801R 8" 449.00
- Siemens Shugart Compatible Model FDD-120-8D 429.00
- PERSCI Model 277 Dual 1195.00
- MPI B52 5¼" Dual 348.00
- WANGO/SIEMENS 82 .... 290.00
- MPI 91 Double Track Density Single Side, 80 Tracks 375.00
- MPI 92 Double Track Density Double Side, 160 Track 475.00

6800 MICROMODULE™ PRICE LIST

MODEL NO.	DESCRIPTION	PRICE
9600A	Single Board Microcomputer	$495.00
9609	Advanced Single Bd. Comp. (6809)	595.00
9601	16 Slot Mother Board	175.00
9602	Card Cage	75.00
9603	8 Slot Mother Board	100.00
9604	Power Supply	275.00
9605	DC Input Power Supply	325.00
9610	Utility Proto Board	39.00
9611	Arith. Proc/Memory Module	495.00
9612	Buffered Utility Proto Board	49.00
9616	32K EPROM/RAM Module	250.00
9617	EPROM Programming Head	250.00
9620	16 Channel Parallel I/O Module	295.00
9622	Serial-Parallel I/O Module	325.00
9627	16K Static RAM Module 470ns	395.00
9629	32K Static RAM 450ns	695.00
9629A	32K Static RAM 200ns	895.00
9630	Card Extender	68.00
9640	Multiple Programmable Timer	395.00
9650	8 Channel Duplex Serial I/O Mod	395.00
9655	Intelligent Tape Controller	550.00
96103	32/32 I/O Module	275.00
96702	Contact Closure Module	350.00

UNPOPULATED BOARDS (Also Available)

$24.95 TRS-80/APPLE $24.95

MEMORY EXPANSION KITS.
4116's. 16K (200/250 ns.)
16K 8 pcs for $24.95 RAM
Specify Computer
Call For Volume Pricing

CENTRONICS PRINTER



Model 737
- Centronics complete printer
- The 737 has everything. Check and compare the features.
- New low price $835.00

32K STATIC RAM BOARD

2 or 4 MHz Expandable uses 2114L's
S-100
- 16K 4 MHz Kit .. 159.95
- 16K 4 MHz A&T . 217.95
- 32K MHz Kit 289.95
- 32K 4 MHz A&T . 339.00
- Bare Board 39.95
- Bare Bd. w/all parts less mem 99.95

NEW! from Zilog

Z-8 CPU comes with Tiny Basie & debug program on the I.C. $69.95 w/data

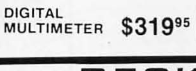
BIPOLAR CPU SALE

Signetics 8 × 300 8 bit CPU
While stock lasts 14.95 ea.

UV "Eprom" Eraser

Model UVs-11E $69.95
Holds 4 Eprom's at a time
Backed by 45 years experience
Model S-52T... $325.00
Professional Industrial Model

NON-LINEAR SYSTEMS, INC. NLS



TOUCH-TEST 20
DIGITAL MULTIMETER $319.95

BECKMAN DIGITAL MULTIMETERS



AS LOW AS 100.00

- TECH 300 Digital Multimeter $110
- TECH 310 Digital Multimeter $140
- TECH 330 Digital Multimeter $189
- VC-201 Vinyl Carrying Case $10
- DC-202 Delxue Carrying Case $24
- HV-211 High Voltage Probe $35
- RP-221 RP Probe $35
- Ct-231 AC Current Clamp $42
- DL-241 Delxue Test Lead Kit $10
- TL-242 Square Test Leads $6

INTERSYSTEMS

The Perferred S-100 Box

The new Series II CPU Board features a 4 MHz Z-80A CPU and full-feature front panel. 20-slot actively terminated mother-board, with 25 amp power supply (50/60 Hz operation, incl. 68 cfm fan).

DPS-1, List $1795

ACP Price $1499



SYSTEM 2A with Z-80A CPU 4 MHz, 64K RAM, I/O Board, 20 slots, front panel, double density disk controller board. Full 1-year warranty.
List $3795 ACP Price $2995

NEC PC-8000 Series Microcomputer System.



NEW INTRO PRICING $1099.00

- Z-80A CPU 4 MHz
- 5 user programmable function keys
- 82 Keys with numeric keypad
- 160x100 resolution
- 80 character screen

PC-8001A Microcomputer w/32KRAM	$1295.00	1099.00
PC-8012A I/O Unit w/32K RAM, Expansion slots	795.00	699.00
PC-8031A Dual Mini-Disk Drive Unit	1295.00	1099.00
PC-8032A Add-On Dual Mini-Disk Drive Unit	1095.00	949.00
PC-8023A Impact Matrix Printer, Tractor/Friction Feed	860.00	769.00
PC-8094A Cable for PC-8023A Printer	49.95	44.95
JB-1201M(A) High Resolution Green Monitor	265.00	239.00
JC-1202DH(A) High Resolution Color Monitor w/RGB Input	1195.00	1049.00
PC-8091A RGB Cable for JC-1202DH(A) Color Monitor	19.95	17.95
Basic Language Learning Guide		19.95
PC-8001A Microcomputer Reference Manual		19.95
PC-8012A I/O Unit User's Manual		14.95
PC-8031A Dual Disk User's Manual		14.95

MICROPROCESSORS

- Z8001 16 bit to 8Mb $189.00
- Z8002 16 bit to 64K 149.00
- Z80 .... 9.95
- Z80A 13.95
- F-8 (3850) 16.95
- 2650 .... 16.95
- CD 1802 .... 9.75
- 8080A 4.75
- 8080A-4MHz 19.95
- **SALE 8085 .... 14.95**
- 8008-1 .... 14.95
- 2901 .... 9.90
- 2901A 14.95
- 2903 4-bit Superslice 29.95
- TMS 9900JL 49.95
- CP1600 .... 39.95
- 6502 .... 9.95
- 6502A 16.95
- IM6100 .... 29.95
- **6800 .... 11.75**
- 6800B 2.0 MHz 19.95
- 6802P 17.95
- 8035 .... 14.95
- 8039 .... 19.95
- INS 8073N 24.95
- 8755 .... 49.95
- 8748 .... 69.95
- 6809 .... 37.95
- 8086 .... 69.95

ADVANCED SUPPORT

- AM9511 Arith. Processor 175.00
- 9512 Arith Processor 175.00
- 9513 Univ. Timing 79.95
- AM9517 DMA Controller 18.95
- AM9519 Universal Interrupt 18.95

Z-80 SUPPORT CHIPS

Z80-PIO	2.5 MHz	8.75
Z80A-PIO	4.0 MHz	12.95
Z80-CTC	2.5 MHz	8.75
Z80A-CTC	4.0 MHz	12.95
Z80-DMA	2.5 MHz	29.95
Z80A-DMA	4.0 MHz	36.95
Z80-SIO/0	2.5 MHz	35.95
Z80A-SIO/0	4.0 MHZ	39.40
Z80-SIO/1	2.5 MHz	35.95
Z80A-SIO/1	4.0 MHz	39.40
Z80-SIO/2	2.5 MHz	35.95
Z80-SIO/2	4.0 MHz	39.40

8080/8085 SUPPORT

- 8155/8156 I/O 24.95
- 8755 I/O with Eprom 64.95
- 8202 Dyn. Ram Cont. 34.95
- 8205/74S 138 Decoder 3.95
- 8212 8 bit I/o 2.75
- 8214 Priority Int. 5.25
- 8216 Bus Driver 2.75
- 8224 Clock Gen. 2.95
- 8224-4 (4MHz) 9.75
- 8226 Bus Driver 2.95
- 8T26 Bus Driver 2.95
- 8228 Sys. Control 4.50
- 8238 Sys. Cont. 5.50
- 8243 I/O Exp. 9.50
- 8250 Asyn. Comm 15.95
- 8251 Prog. I/O 6.95
- 8253 Int. Timer 12.95
- 8255 Prog. I/O 6.50
- 8257 Prog. DMA 16.95
- 8259 Prog. Int. 15.95
- 8275 CRT Controller 45.95
- 8279 Prog. Keyboard 15.95

6800 SUPPORT CHIPS

- 6810 128 x 8 Ram 4.75
- 6820 .... 6.50
- 6821 .... 6.50
- 6828 Priority Int. 10.75
- 6834-1 512 x 8 Eprom 16.95
- 6845/HD46505 CRT Cont. 29.95
- 6847 Color CRT 29.95
- 6850 ACIA 5.95
- 6852 Serial Adapter 5.95
- 6860 Modem 10.95
- 6862 Modulator 11.95
- 6871A 1.0MHz OSC 25.95
- 6875 .... 6.95
- 6880 Bus Driver 2.19
- MC68488 .... 19.95
- 68047 .... 24.95

6502 SUPPORT CHIPS

- 6520 PIA 7.50
- 6522 Mult. 11.95
- 6530-002,003,004,005 .... 21.95
- 6532 .... 19.95
- 6551 .... 19.95

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We do Custom Programming

- 82S23/6330/5600/74S188 .... 4.25
- 82S115 (512x8)TS 12.95
- 82S123/5610/74S288 (32x8)TS .. 4.25
- 82S126/5603/74S387 (256x4)OC 4.25
- 82S129/5623/74S287 (256x4)TS . 4.25
- 82S130/5604/74S570 (512x4)OC 6.50
- 82S131/74S571 (512x4)TS 6.95
- 82S137/74S573 (1024x4)TS 12.95
- 82S141/3624/74S474 (512x8)TS 12.95
- 82S147/74S472 (512x8)TS 12.95
- 74S471/6309 (256x8)TS 7.95

MOS PROMS

- 2764 (8Kx8)TS 89.95
- 2732 (4Kx8)TS 16.95
- 2716/2516;5V (2Kx8)TS 8.95
- TMS2716, ± 5V, 12V 17.95
- 2758, 5V, (450Ms) 7.50
- 2708 (450Ms) 5.75
- 2708 (650Ms) 5.25
- 1702A 5.75
- MM5203AQ 14.50
- MM5204Q 9.95

CHARACTER GEN.

- 2513-001 (5V) Upper 9.50
- 2513-005 (5V) Lower 10.95
- 2513-ADM3 (5V) Lower 14.95
- MCM66710 Ascii Shifted 12.95
- MCM66740 Math Symbol 13.45
- MCM66750 Alpha Control 13.45

UARTS/BAUD RATE

- TR1602B (5V. 12V) 3.95
- AY51013 (5V. 12V) 4.95
- AY51014A/1612 (5-14V) 6.95
- AY51015A/1863 (5V) 6.95
- IM6402 .... 7.95
- IM6403 .... 8.95
- 2350 USRT 9.95
- 1671B Astros 24.95
- **SALE TR1472B 9.95**
- MC14411 .... 11.95
- 4702 .... 14.95
- WD1941 .... 9.95
- COM 5016 .... 16.95
- INS 8250 .... 15.95

KEYBOARD ENCODERS

- AY5-2376 .... 13.75
- AY5-3600 .... 13.75

STATIC RAMS

SALE 2102 .89

	1-24	25-99	100
21L02 450ns	1.30	1.25	.99
21L02 250ns	1.59	1.55	1.15
2111	3.75	3.65	3.55
2112-1	2.95	2.85	2.65
2101-1	2.90	2.70	2.55
2114N (450 MS.)	3.75	3.50	3.25
2114L-250ns. (4045)	6.50	5.95	5.50
2114L-450ns. (4045)	4.75	4.25	3.95
4044 250 ns.	8.95	7.50	6.90
4044 450ns.	5.95	5.95	4.75
EMM4200A	9.75	8.75	7.95
EMM4402	7.95	7.25	6.25
AMD9140/41	10.95	10.25	9.25
AMD9130/31	12.95	11.95	10.25
1101	1.95	1.75	1.25
P2125/93425 (45ns.)	9.95	8.35	6.25
6518 1K x 1 CMOS	7.95	7.95	7.25
2147 Low Power 4K Static	9.95	8.95	6.95
93415	9.95	8.95	6.50

DYNAMIC RAMS

- 416/4116 16K (16 Pin) 2.49
- Set of 8 416's 200 MS 24.95
- 4115 8K (16 Pin) 2.49
- 4050 4K x 1 (18 Pin) 4.95
- 4060 4K x 1 (22 Pin) 4.95
- 4096 4K x 1 (16 Pin) 3.95
- 2104 4K x 1 (16 Pin) 4.75
- 4027 4K x 1 (16 Pin)/UPD 414 .... 4.95

5261	1.95	1103	.95
5262	1.95	4008L	4.95
5270	4.95	6605	7.95
5280	4.95	6604	4.95
		6002	1.50

64K RAMS $19.95

SOCKETS

# Pins	Lo-Pro Soldertail	Wire Wrap 3 Level Tin	Wire Wrap 3 Level Gold
8	15	32	45
14	19	36	59
16	20	38	62
18	24	59	84
20	29	69	99
22	24	79	1.10
24	38	85	1.20
28	43	1.10	1.49
36	58	1.25	1.69
40	60	1.40	1.89

ZERO INSERTION FORCE

16 Pin $5.50 24 Pin $7.50 40 Pin $10.25

LED READOUTS

Part No	Size	Color	Description	Price
DL704	300	Red	Comm. Cathode	99
DL707	300	Red	Comm. Anode	99
FND357	357	Red	Comm. Cathode	99
FND501	500	Red	Comm. Cathode (+1)	99
FND503 (500)	500	Red	Comm. Cathode	99
FND507 (510)	500	Red	Comm. Anode	99
FND508	500	Red	Comm. Anode (+1)	99
FND530	500	Green	Comm. Cathode	149
FND550	500	Orange	Comm. Cathode	149
FND803 (800)	800	Red	Comm. Cathode	175
FND807 (810)	800	Red	Comm. Anode	175
HP5082-7340	600	Red	4 x 7 Hexidecimal	25.95
HP5082-7300	600	Red	4 x 7 Sgl. Digit RHD	18.95
HP5082-7731	300	Red	Comm. Anode	75
TIL305	-	Red	Array 5 x 7	795
TIL308	270	Red	Numerical Display	1095
TIL309	270	Red	Numerical Display	995
TIL311	270	Red	4 x 7 Hexidecimal	1095
MAN2A	320	Red	Array	595
MAN10A	270	Red	Alpha Numeric	895
XAN3061	300	Red	Comm. Anode Right DP	125
XAN3062	300	Red	Comm. Anode Left DP	125
XAN3063	300	Red	Overflow CA Left DP	125
XAN3064	300	Red	Comm. Cathode Right DP	125
XAN3051	300	Green	Comm. Anode Right DP	199
XAN3052	300	Green	Comm. Anode Left DP	199
XAN3053	300	Green	Overflow CA Left DP	199
XAN3054	300	Green	Comm. Cathode Right DP	199
XAN3081	300	Yellow	Comm. Anode Right DP	210
XAN3082	300	Yellow	Comm. Anode Left DP	210
XAN3083	300	Yellow	Overflow CA Left DP	210
XAN3084	300	Yellow	Comm. Cathode Right DP	210

IC SPECIAL PURCHASE

- 82S09 64x9 Ram 8.95
- DP8304 Octal Driver 2.95
- DAC86EX D/A Conv. 6.95
- MC1650 Hi Speed A/D 7.95
- MC6852 SSDA 3.49
- MC10145 16x4 ECL Ram 4.50
- MK3850/F8 CPU 4.95
- MK3853 Static Mem I/O 4.95

SN75136	.46	78M06	.49
MC10210	.89	79M06	.49
LM339	.79	74157	.49
LM710CN	.29	74161	.49
LM711CN	.29	74C74	.39

- ICM 7045 Precision StopWatch 23.95
- ICM 7207 Oscillator Controller 7.50
- Seven Decade Counter 7208 .... 18.95
- MC14433P 3½ Digit A/D Converter 13.95
- ICL 8211 Voltage Reference 1.95
- LM 1850N Ground Fault IC 3/1.00
- LM 2900N Quad Amplifier 2/1.00
- LM 2917N Freq. to Volt Conv. 2/1.99
- AY-3-3550 4¾ digit DMM 24.95
- AY-5-3507 40MHz DVM 9.95
- MEM 4963 Mosfet Smoke Detector 7.95
- 27S08 32 x 8 Prom (IM 5600) 2.95
- ULN 2003A 7 channel Driver .... .99
- MCM 14505 64 bit Static Ram 6.95
- MOC 1003 (4N28) Opto Coupler 3/1.00
- SPX33 Opto Coupler 3/1.00
- IH 5045 CMOS Switch DBST 4.50
- UA 3045 Trans. Array 1.25
- TR 1402A UART 1.95
- MK 1007 Dyn. Mem. Shift Reg. 3.95
- 5318 TV Ch. Disp. Circuit 4.50
- 8080A 8 Bit CPU 4.95
- 8700 CJ 8 Bit A/D 9.95
- MM5280/VPD 411/C2 107/TMS 4060/ 4Kx1 Dynamic 22 Pin RAM 1.75
- 6604/VPD 414/4027/2660/MK 4096/ 4Kx1 Dynamic 16 Pin 1.95

7520/25	.50	LM 387	1.25
1488/1489	2/1.99	LM 4558	3/1.99
LM323K	4.95	RC 4136	2/1.99
MC1372	8.95	RC 4131	2/1.99
MM5298-4A B	2.95	COM 5027	39.95
LM 377	1.25	COM 5037	49.95
LM380	1.25		

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100% CERTIFIED ERROR-FREE!

● 35 TRACKS, DOUBLE DENSITY SINGLE-SIDED 5¼

TYPE	DESCRIPTION	PRICE BOX 10
525-01	Soft Sectored TRS 80 etc	$29.95
525-10	10 Hole Hard NS. Apple etc	$29.95
525-16	16 Hole Hard Micropolis	$29.95

● 40 & 77 TRACK DOUBLE DENSITY – SINGLE SIDED 5¼ W/HUB REINFORCEMENT RING

577-01	Soft Sectored TRS 80 etc	$32.25
577-10	10 Hole Hard NS. Apple etc	32.25
577-16	16 Hole Hard Micropolis	32.25

● 40 TRACKS, DOUBLE SIDED DOUBLE DENSITY 5¼

550-01	Soft Sectored SA 450 MPI 52	$39.95
550-10	10 Hole Hard BASF WANGCO	$39.95
550-16	16 Hole Hard Micro²	$39.95

● 8" 100% CERTIFIED DISKETTES

FD800-01	Soft Single Density 3740	$33.50
FD800-32	32 Hard Single Density Shug	33.50
FD802-01	Soft Double Density 3740	44.80
FD850-01	Soft Double Sided Double Density 3740	49.80

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- 1791-01 Dual Floppy 36.95
- 1791-02 Dual Floppy 44.95
- 1793 DD, DS Floppy 44.95
- 1797 DD, DS Floppy 54.95
- 1691 Data Separator 18.95
- 2143 Clock Gen. 18.95

FLOPPY CHIP SET

Double Density
Double Sided Includes: 1797, 1691, 2143
$79.95/set

A/D CONVERTERS

- 8700 8 bit Binary 13.50
- 8701 10 bit Binary 22.00
- 8703 8 bit TS 13.50
- 9400 Volt to Freq. Conv. 7.25
- 8750 3½ Digit BCD 13.95
- 1408L6 6 bit 3.95
- 1408L8 8 bit 5.95
- DACOI D to A 5.95
- DAC08 .... 9.95
- DAC 100 .... 9.95

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- AY38500-1 6 Games B/W 4.95
- AY38515 Color Converter 2.95
- AY38603-1 Roadrace Game 8.95
- AY38606-1 Wipeout Game 9.50
- AY38607-1 Shooting Gallery 6.95
- AY38910 Sound Generator 12.95
- SN76477 TI Sound Generator 3.95
- MM5320/21 TV Synch Gen. 9.95
- MM5369 Prescaler 3.95
- LM1889 RF Modulator 3.95
- MM57100 NSC Color TV 6.95
- MM57104 Clock Gen. 3.75
- M&R Modulator 29.95

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- 8038 Function Gen. 4.50
- MC4024VCO 2.95
- LM566 VCO 1.95
- XR2206 Function Generator 5.25

SHIFT REGISTERS

2504V	1.49	MM500H	.50
2507V	1.49	MM5056N	2.95
2517V	1.49	MM5060N	2.95
2524V	1.49	2510A	1.95
2525	1.49	2847	4.95
2527	1.49	3341	4.95
2528	1.49	3351	17.95
2529	1.49	3357	6.95
2533	1.49	9403	24.95
3347	5.95	9408	9.95

CTS DIPSWITCHES

CTS206-2	1.75	CTS206-7	1.75
CTS206-4	1.75	CTS206-8	1.95
CTS206-5	1.75	CTS206-9	1.95
CTS206-6	1.75	CTS206-10	1.95

CONNECTORS (GOLD)

- DB25P (RS232) 3.25
- DB25S Female 3.75
- Hood 1.25
- Set w/Hood, Sale $7.50
- 22/44 W/W, S/T, KIM 2.95
- 43/86 W/W, S/T, MOT 6.50
- 50/100 S-100 Connector w/w 4.95
- 50/100 S-100 Connector s/t 3.95

NAKED PC

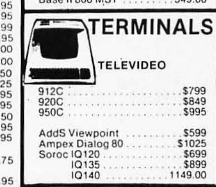
- S-100 Sound Board $34.95
- 8080A CPU 34.95
- 32K Static RAM (2114) 39.95
- 8K Eprom (2708) 24.95
- 2708/2716 Eprom 34.95
- ACP Proto Bd. 22.95
- Vector 8800 Proto 22.20
- Vector 8803 11 slot MB 29.95
- ACP Extender w/Conn. 18.95
- 13 Slot MotherBoard (WMC) 32.95
- 9 Slot MotherBoard (WMC) .. 29.95
- 8 Slot Mother (Expandable) .. 34.95
- Floppy PCB (8" SHUGART) 39.95
- S100 (AY5-8910) Sound Bd .. 34.95
- Apple Sound Bd. 24.95

PRINTERS

EPSON

- MX-80 .... $495.00
- MX-80 FT 595.00
- MX-100 .... 895.00
- MX-70 .... 425.00
- Centronics 739 .... 799.00
- Vista V-300/25 cps 1495.00
- V-300/45 cps 1795.00
- Malibu 165 .... 1995.00
- Anadex 9500/9501 .... 1450.00
- Base II 800 MST 549.00

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TELEVIDEO

- 912C $799
- 920C $849
- 950C $995
- AddS Viewpoint $599
- Ampex Dialog 80 .... $1025
- Soroc IQ120 .... $699
- IQ135 .... $899
- IQ140 .... 1149.00

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- VM4509 9"BW Sale Price 159.95
- DM5012 12" B/W 239.00
- DM5112 12" Green 249.00
- DM6013 13" Color 415.00
- NEC Green 259.00
- AMDEK/LEEDEX Video 100 149.00
- AMDEK/LEEDEX 13" Color 399.00
- AMKEK/LEEDEX 12" Green 179.00

TERMS: Use check, M/C, VISA, AMEX, CB, or COD. COD requires 25% deposit. Charge Orders please include expiration date. Foreign pay U.S. Funds. Order by phone, mail or TWX. MINIMUM $10.00. Please include magazine issue and phone no. SHIPPING: U.S.A. add $2.00 for first 2 lbs. For surface add 30¢ for additional lbs. For air add 70¢ for additional lbs. FOREIGN: Add 10% shipping and handling. COD's $1.85 extra. Not responsible for typos. Some items subject to prior sale. We reserve right to limit quantities, some items subject to precious metal adder. Retail pricing may vary from Mail Order. We reserve the right to substitute manufacturer.

RETAIL STORES OPEN MON-SAT

STORE #1: 1310 "B" E. Edinger, Santa Ana, CA 92705 Showrooms, Retail, Warehouse
STORE #2: 542 W. Trimble Road, San Jose, CA 95131 • (408) 946-7010
RETAIL PRICING MAY VARY

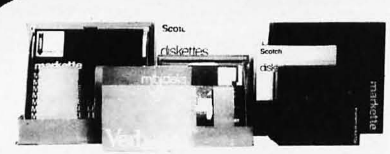
P.O. Box 17329 Irvine, Calif. 92713
Direct Order Lines: (714) 558-8813
(800) 854-8230 or (800) 854-8241

FOR INTERNATIONAL ORDERS:
1310 E. Edinger (714) 953-0604
Santa Ana, CA 92705 TWX: 910-595-1565

Circle 6 on inquiry card.

California Digital

Post Office Box 3097 B • Torrance, California 90503



DISKETTES

FREE PLASTIC LIBRARY CASE INCLUDED WITH THE PURCHASE OF EVERY BOX OF DISKETTES

Private labeled for California Digital by one of the most respected producers of magnetic media. Each diskette is certified double density at 40 tracks. To insure extended media life each diskette is manufactured with a reinforced hub-hole. And of course, a plastic library case is included with every box of diskettes. MMD-CD5(01)(10)
Please specify computer or required sectors.

$24.95 BOX

Ten boxes $22.75 One hundred boxes $21.50

MINIDISKETTES	Box	10 boxes		Box	10 boxes
Memorex 3401	$27.00	$25.00	Scotch 744(0)(10)(16)	$31.00	$29.00
Verbatim 525(01)(10)	29.00	27.00	Dysan	45.00	43.00

EIGHT INCH	Scotch	box	10 bx.	Dysan	box	10 bx.	MRX	box	10 bx.
Single side/single den.	740-0	$35.	$33.	3740/1	$49.	$47.	3060	$ 5.	$ 3.
Single side/double den.	741-0	45.	43.	3740/1d	75.	73.	3090	37.	35.
Single side/32 sector	740-32	35.	33.	na.			na.		
Double side/ double D.	743-0	65.	59.	na.			3115	49.	45.

SCOTCH brand head cleaning kit. $24.95 MMA-CK(5)(8) please specify 5 1/4 8"
Prices available on request for: tape, cartridges, diskpacks, volumn diskettes.

MEMORY

TRS-80 APPLE II $25
16k memory (8) 4116's

Factory prime. Unconditionally guarenteed for one full year.
Add $3.00 for TRS-80 jumpers and instructions.

DYNAMIC

	ea.	32+	100+	1K+
4116- 200ns	3.25	3.00	2.75	2.50
4116 150ns	3.75	3.50	3.25	3.00
4164 64K	49.50	45.00		

STATIC

21L02 450ns.	1.19	1.05	.99	
21L02 250ns	1.49	1.45	1.39	
2114L4 450ns	3.95	2.95	2.75	2.50
2114L3 300ns	4.25	3.75	3.00	2.75
4044-4 450ns	4.95	4.50	4.25	4.00
4044-2 250ns	5.50	4.95	4.50	4.35
5257-3 300ns	4.47	4.25	4.05	3.75

EPROM

2708 450ns	4.95	4.50	3.75	3.25
2716 5V.	7.95	6.50	5.00	4.50
2716 tri-volt	9.95	9.00	8.25	7.50
2732 Intel	19.00	17.50	16.00	
2532 TI	21.50	19.00		
2764	*			

direct connect MODEM — **Your Choice $169**

Direct connect modems eliminate loss of information due to the carbon compression associated with acoustic modems. Choose either of these two great units.

The Universal Data Systems 103LP is switch selectable between answer and originate modes. Fully Bell 103 compatable. Directly connects to the new modular telephone jack. 100% powered from the telephone line. No need to locate modem in proximity to A.C. power recepticle. MOD-103LP 2 pounds.

Novation "D" Cat connects to most of the new "Bell" modular handsets. Ideal for multiple line office telephones. Requires external A.C. power. MOD-DCAT 2 Lb.

UDS 103J/LP AUTO ANSWER $219

26 Megabyte Hard Disk Drive from GEORGE MORROW'S Thinker Toys

$3495

Other Morrow Products.			
Additional hard disk	$3650	Disc Jockey 2D controller	$345
Discus 2D 1 drive	950	Disk Jockey 1 Controller	195
Discus 2D 2 drives	1627	M26 hard disk Controller	625
Discus 2+2 1 drive	1250	Switchboard interface	219
Discus 2+2 2 drives	2237	"New" Multiboard	275
		M-10 Ten Megabyte hard	2550

MEMOREX 8" DISKETTES $25

Recently the Memorex Corporation had a cancellation on a contract for a truck load of eight inch diskettes. California Digital was fortunate to be offered this load of prime magnetic media.

These diskettes are "UNBRANDED" but are guaranteed first quality Memorex Brand. (#3060 single den.)

Like all diskettes sold by California Digital, a library case is supplied free with the purchase of every box.

This offer is subject to remaining inventory on hand.



BSR SYSTEM X-10

The new BSR timer runs your home just like clockwork. Turns on lamps and appliances while your away from home. Completely compatible with your existing System X-10 devices.

BSR Timer eight channel	$65.00	Appliance Module 500 W.	$13.95
Master control console	34.95	Lamp Module 300 Watts	13.95
Ultrasonic Controller	19.95	NEW full control wall switch	14.50

S-100 Mother Board $35

Quiet Buss™

8803-18
18 slot
IMSAI



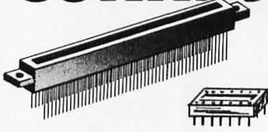
SWITCHES



DIP SWITCHES pos.	ea.	100+	1K+
4	.88	.75	.69
7	.99	.83	.79
8	1.05	.91	.87
12	1.19	.99	.91

TOGGLE		ea.	100+
7101	on/on	1.19	.98
7103	on/off/on	1.39	1.19
7107	mnt. on	1.39	1.19
7108	mnt. on	1.39	1.19
7205	dpdt mnt	1.85	1.65

CONNECTORS



GOLD EDGE CONNECTORS

S-100 .125" centers	each	10+
Imsai solder .250" row	$2.95	$2.50
Imsai wire wrap (TI)	3.95	3.50
Sullins Hi-Rel. .250"	4.50	4.00
Sullins Hi-Rel. W/W	5.35	4.90
Sullins / Altair .140"	4.95	4.50
.156" Centers (standard)		
22/44 Kim Eyelet	2.50	2.15
36/72 Digital Group S/T	5.95	5.50
36/72 Digital Group W/W	6.60	6.15
43/86 Motorola 6800 S/T	6.60	6.15
43/86 Moto. 6800 W/W	7.00	6.85

INTEGRATED CIRCUIT SOCKETS

	Low Profile each	Low Profile 100+	Wire Wrap each	Wire Wrap 100+
8 pin	$.10	$.09	$.46	$.41
14 pin	.10	.09	.45	.41
16 pin	.12	.11	.50	.45
18 pin	.15	.13	.68	.61
24 pin	.26	.24	.94	.87
40 pin	.42	.40	1.60	1.47

"D" Type	each	10-24	25+
DE9P male	$1.60	$1.40	$1.30
DE9S female	2.25	2.00	1.90
DE hood	1.50	1.35	1.20
DA15P male	2.35	2.15	2.00
DA15S female	3.25	3.10	2.90
DA hood 2/P	1.60	1.35	1.30
DB25P male	2.50	2.35	2.25
DB25S female	3.35	3.15	3.05
DB hood 2/P	1.35	1.15	1.05
DC37P male	4.20	4.00	3.70
DC37S female	6.00	5.75	5.50
DC hood 2/P	2.25	2.00	1.75
DD50P male	5.50	5.10	4.75
DD50S female	9.40	8.60	8.00
DD50 hood 2/P	2.60	2.40	2.10
CENTRONICS			
57-30360	7.95	6.75	5.75
RIBBON CABLE CONNECTORS			
17/34 5" disk	4.85	4.15	3.95
20/40 TRS-80	5.65	5.05	4.70
25/50 8" disk	5.90	5.15	4.90



S-100 MAINFRAME

Mainframe includes 117/230 volt power supply and your choice of a six or twelve slot motherboard.
Six slot enclosure is supplied with mounting provisions for one 5 1/4 floppy disk or Winchester drive.
AC receptacle is provided for terminal or other accessory. Chassis has been punched to accept six assorted computer connectors.
Shipping weight 37 lbs. ENM-CD1 $265.00

Shugart Associates



$395
801/ R Disk Drive 15 lbs.

Shugart 801/R with CP 206 power supply, muffin exhaust fan, complete in dual enclosure with all the necessary harnessing cables. Documentation included. 36 pounds. MSD-1801 **$795**
Same as above but with two Shugart 801R disk drives. 50 pounds. MSD-2801 **$1195**
Disk drive cable. 6 feet 50 conductor with edge card connector at both ends. WCA-650S $25.00
Export Disk drives. 220V. 50MHz add $50.00 per disk drive.

SHUGART 801R $395

Qume Double Sided 8" Disk Drive $575



NEW from Shugart Technology 5 Megabyte Hard Disk Drive

Packaged in the same physical size as the industry standard 5 1/4" minifloppy disk drive. The micro-Winchester stores thirty times as much data (6.38 megabytes unformatted), accesses data twice as fast (170 milliseconds) and transfers data twenty times faster (5.0 megabits per second.)

The ST506 is factory sealed to protect the media from environmental contaminates. Requires only DC voltage.

Dual California Digital 5 1/4" enclosure, ST506 drive and power supply. **$1500**

Shugart Associates SA400 removable media disk drive for above package. add: **$300**
S-100 & Apple controller scheduled for spring release.

DATA INPUT TERMINAL

This Keystation terminal was recently acquired from the CMC division of the Pertec Corporation. The unit was originally designed for inputing data directly onto magnetic tape.

The system is comprised of a premium cast aluminium and fiberglass enclosure, along with a Honeywell / Microswitch hall effect keyboard. Thirty display lamps advise the operator of the systems status. Four inch loud speaker acknowledges acceptance of data and alerts the operator of pending problems.

But most of all this "USED" terminal, with a little imagination, can be engineered to make the perfect home for an S-100 computer and video display; or with slight modification will accept the Rockwell AIM-65 micro/computer.

Five volt regulated power supply is available for an additional $20.
All units are in excellent condition. Original acquisition over $700. 22 lbs.

Regulated Power Supply 5 VOLT 5 AMP $11.95



This USED surplus power supply was removed from working equipment. Pass transistor regulation outputs five volts at a conservative five amps. Suitable for TTL hobby applications. SPC-PS1 8 pounds.

VISA



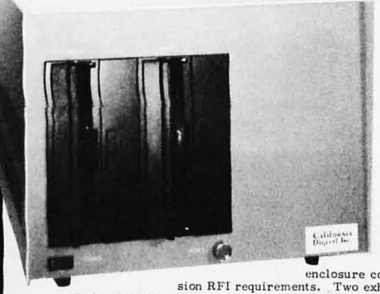
All merchandise sold by California Digital is premium grade.
Shipping: First five pounds $2.00; each additional add $.40
Foreign orders 10% shipping. Excess will be refunded.
California residents add 6% sales tax. COD's discouraged.
Open accounts extended to state supported educational institutions and companies with a "Strong Dun & Bradstreet."
Warehouse: 15608 Inglewood Blvd. Visitors by appointment.

TOLL FREE ORDER LINE (800) 421-5041
TECHNICAL & CALIFORNIA (213) 679-9001
TWX 910 325-6212

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California Digital

Post Office Box 3097 B • Torrance, California 90503



Enclosure for Two 8" Disk Drives and 12 Slot Motherboard

$375

Modular in concept...designed for cost effective system integration. Buy as much as you require. The basic enclosure is engineered from welded structural steel. RF line filter insures that the enclosure conforms to the Federal Communication Commission RFI requirements. Two exhaust fans provide maximun airflow across printed circuit cards. The enclosure has mounting provisions for two 8" Qume for Shugart disk drives and a 10 megabyte Winchester drive. The basic package is supplied with two AC accessory receptacles and all AC and DC power cables. Rear panel has been machined to accept nine assorted computer connectors. Shipping weight 30 lbs. ENM-2D $375.00

POWER SUPPLY mounts into basic enclosure, supports two 8" disk drives and 12 slot motherboard. Shipping weight 15 lbs. PSS-2D $99.00

MOTHERBOARD with noise canceling basket-weave ground plane. Complete with twelve gold S-100 edge connectors and card cage. Shipping weight 3 lbs. BDB-MTH12C $99.00

World's Best Selling Printer

EPSON MX80

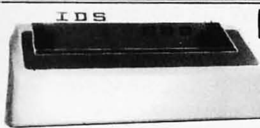
Immediate Delivery

Only $475

Correspondence quality printing.
A lot of printers costing a lot more can't touch the MX-80's performance. It gives you a choice of 40, 80, 66 or 132 columns of printing in as many as four distinct printing density modes, a total of twelve different combinations which can accommodate nearly any printing requirement.

Bidirectional printing. Logical seeking of shortest lines. 80 CPS. 64 graphics characters. Forms handling. The list of standard features goes on and on. The fact is that there are few printers that can compete with the MX-80 at ANY price. And none—ZERO—in its extraordinarily affordable price range.

ABCDEFGHIJKLMNOPQRSTUVWXYZABCDEFGHIJ



Paper Tiger 560G

$1350

IBM 3101 Display Terminal

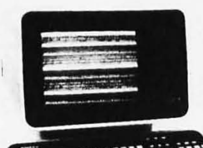
IBM Direct Price $1295

California Digital discount price $1195



NEC Spinwriter 5510P/S $2795

The word processing quality Spinwriter prints at speeds upto 55 characters per second. The Model 5510 P/S is supplied with both parallel and RS-232 serial interfacing. Also included is the tractor feed mechanism, along with print thimble and ribbon. PRN-5510PS 70 lbs. Keyboard (KSR) Model 5520 P/S available $2995. PRN-5520PS 75 lbs.



AMPEX DIALOGUE 80 CRT TERMINAL

$995

New from the Ampex Corporation. The Dialogue 80 features removable keyboard, displayable two pages (four optional) dual program keys, half intensity protected fields and status line. Transmits data either block, line or character mode. Excellent value. VDT-D80 shipping 47 lbs.



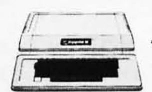
PRINTRONIX

P-300 $4500
P-600 $6150

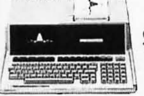
PRINTERS

Epson MX80	PREMX80	$475
Epson MX80FT	PREMX80F	595
Epson MX100	PREMX100	825
Anadex 9500	PRA9500	1295
Anadex 9501	PRA9501	1295
Anacom 150	PRA150	1075
IDS Paper Tgr.	PRG460G	1095
IDS Tiger 560	PRG560G	1350
Diablo 630	PRD630	2150
Diablo 1650	PRD1650	2850
Diablo 1640	PRD1640	2496
Datasouth 180	PRD180	1350
Printronix 300	PRP300	4500
Printronix 600	PRP600	6150
NEC/Sellum 1	PRN5510ps	2695
NEC/Sm 16K	PRN5516ps	2795
TEC/Starwrit.	PRV300	1395
Okidata 80	PRO80	419
Okidata 82	PRO82	619
Okidata 83	PRO83	895
Teletype 43K	PTT4320K	1095
Texas Ins. 810	PRT810B	1450
Tex. Ins 810C	PRT810C	1795
Centronics 730	PRC730P	529
Centronics 737	PRC737P	695
Centronics 739	PRC739P	795
Centrnx 704-9	PRC704-9	1495
Centrnx.704-11	PRC704-11	1569

SYSTEMS



APPLE II 48K MEMORY **$1170**



$2650 HEWLETT PACKARD **HP85**

Hew/Pack 85	SYSHP85	2650
Hew/Pack 83	SYSHP83	1895
Altos ACS8000	SYSACS8000	4795
Osborne 1	SYSOB1	1795
Commodore	SYSC8032	1495
Commodore	SYSC8096	1795
Superbrain64Q	SYSSB64Q	$3350
Superbrain64D	SYSSB64D	2850
Northstar 64Q	SYSN64Q	3295
Northstar 64D	SYSN64D	2895
NEC/PC8000	SYSPC8000	call
Apple II Plus	SYSAP	1170

VIDEO TERMINALS

ADDS Regent 25 numeric cluster	VDT-R25	$850
ADDS Regent 30 25th status line	VDT-R30	950
ADDS Regent 40 limited graphics	VDT-R40	1195
ADDS Regent 60 Block mode	VDT-R60	1495
Ampex Dialouge 80 two page,detatch	VDT-D80	995
Digital Equipment VT-100	VDT-V100	1595
Digital Equipment VT-132	VDT-V132	1895
Direct VP-800A emulator	VDT-P800	call
Hazeltine 1410	VDT-H1410	750
Hazeltine 1420	VDT-H1420	795
Hazeltine 1500	VDT-H1500	850
Hazeltine 1510	VDT-H1510	1025
Hazeltine 1520	VDT-H1520	1225
Hewlett Packard 2621A	VDT-HP21A	
Hewlett Packard 2621P	VDT-HP21P	
IBM 3101-10 character mode green	VDT-3101	1195
IBM 3101-20 block mode	VDT-31012	1395
Lear Seigler 3A upper case only	VDT-L3A	850
Lear Seigler ADM5	VDT-L5	945
Lear Seigler ADM31	VDT-L31	1385
Lear Seigler ADM42	VDT-L42	1995
Soroc IQ 120	VDT-Q120	675
Soroc IQ 135 NEW	VDT-Q135	850
Soroc IQ 140 detatchable keyboard	VDT-Q140	1150
Televideo 912C	VDT-T912	665
Televideo 920C	VDT-T920	745
Televideo 950C detatchable keybd.	VDT-T950	985
Zenith Z-19	VDT-Z-19	735

VIDEO MONITORS



BMC KG12C 18MHz P-31 grn phosphor	$259
Leedex/Amdek 12"100	129
Leedex 100 green	169
Leedex 100-80	197
Hitachi color 13"	389
Zenith color 13"	379
NEC green phosphor	219
Panasonic color 10"	
Sanyo 9" BW	149
Sanyo 12" green phos.	235
Sanyo 15" BW	259
Sanyo 13" color	419

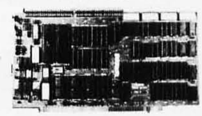
ACCESSORIES FOR THE APPLE COMPUTER

CALIFORNIA COMPUTER SYSTEMS	
Arithmetic Processor 7811 B/C	$319
Asynchronous serial interface 7710	129
Centronics Interface card 7728	95
12K PROM Module 7114	69
Calender/Clock, Bat. back-up 7424	99
Parallel Interface 7720A	99
Programable Timer 7740A	99
Analog/Digital converter 7470A	99
MICROSOFT PRODUCTS	
Apple to Z-80 CPU card	379
D. C. HAYES PRODUCTS	
Micromodem for Apple	319
COMPUTER STOP PRODUCTS	
Double Vision / 80 Column Video	250
INTERACTIVE STRUCTURES	
16 Channel A/D card AIO/2	275
MOUNTAIN COMPUTER PRODUCTS	
Intro X-10 system for BSR	$239
Intro X-10 card only	165
16 channel AD/DA 8 bit	319
Apple Clock battery back-up	225
Supertalker SD200	245
ROM Plus with filter	165
ROM Writer/Programmer	149
APPLE BRAND PRODUCTS	
Apple Language card	450
Floppy disk with controller	560
Floppy disk without controller	495
Apple parallel interface	175
SSM MICROCOMPUTER	
Dual serial parallel interface AIO	
SORRENTO VALLEY ASSOCIATES	
8" floppy controller (Pascal)	360

S-100 BOARDS

Assembled • Tested • Burned-in





CPU BOARDS		
Calif. Computer 2810A Z-80 DMA, 4MHz	BDC-C2810	$250
Godbout Z-80 24 bit, 4MHz	BDC-GZ80	239
Godbout 8085/8088 dual 16 bit processor	BDC-G88	375
Measurement Systems Z-80 4 serial 2 parallel real time clock, 8 vector	BDC-MZ80	395
SD Systems SBC-200 Z-80 with serial & parallel I/O ports	BDC-SBC2	385
Teletek FDC-1 single board CPU & floppy disk controller plus I/O	BDC-FDC1	695
MAINFRAMES		
Calif. Computer 2200A 12 slot & power supply	ENM-C2200	349
TEI 12 slot table	ENM-T12	495
TEI 22 slot table	ENM-T22	650
Godbout mainfrm.	ENM-GMF	
MEMORY BOARDS		
Calif. Computer 2065A 64K dyamic memory	BDM-C2065	$429
Calif. Computer 2016 16K static memory	BDM-C2016	259
Calif. Computer 2032 32K static memory	BDM-C2032	585
Godbout Ram 17 64K static memory 16 bit	BDM-G17	1025
SD Systems Expandoram II 16K dynamic	BDM-EX16	295
64K dynamic	BDM-EX64	375
Measurement Systems DMB6400 for Alpha Micro	BDM-M6400	685
EPROM BOARDS		
Digital Research 32K, 2716 proms extra	BDM-DP32	99
SD Systems Prom-100 programmer	BDM-P100	250
FLOPPY DISK CONTROLLER		
Calif. Computer 2422A with 2.2 CPM	BDF-C2422	329
Godbout "Disk One" features the NEC 765 controller, DMA arbitration	BDF-GD1	395
Measurement Systems 765 chip, single & double density, Error recovery	BDF-MF	419
SD Systems Versafloppy II double density	BDF-VF2	419
Tarbell D/D	BDF-TF2	419
Morrow Design Disk Jockey I single density	BDF-DJ1	195
Morrow Design Disk Jockey II double density	BDF-DJ2	345
INTERFACE BOARDS		
Calif. Computer 2718 I/O 2 serial/2 par'l	BDT-C2718	
Morrow Designs Switchboard 2 serial/4 par'l	BDT-MSB	219
Morrow Designs Multiboard 3 serial/3P. +++	BDT-MMB	275
Godbout Interfacer One 2 serial/2 par'l	BDS-GB1	199
Godbout Interfacer Two 1 serial/3 par'l	BDS-GB2	199
SPECIALITY BOARDS		
QT Computer real time clock/calendar	BDS-QCK	135
Artec Elec. Wire wrap prototype board	BDS-AWW	25
Artec Elec. General Purpose proto board	BDS-AGP	25
Godbout Spectrum color board	BDS-GSC	295
D. C. Hayes S-100 Micromodem	BDS-HM1	350
Mullen Products extender board & logic probe kit	BDS-MTB1	49
Mullen Products Opto-contro board kit	BDS-MOC	139

Rotron Muffin Fan



$14.77
$12.00 @ 100
10.50 @ 1000

115 VAC. 7 Watts WR2A1
Factory fresh Muffin fans
NOT pull-outs. EMF-4M

VISA



All merchandise sold by California Digital is premium grade. Shipping: First five pounds $2.00; each additional add $.40. Foreign orders 10% shipping. Excess will be refunded. California residents add 6% sales tax. COD's discouraged. Open accounts extended to state supported educational institutions and companies with a "Strong Dun & Bradstreet." Warehouse: 15608 Inglewood Blvd. Visitors by appointment.

TOLL FREE ORDER LINE (800) 421-5041

TECHNICAL & CALIFORNIA (213) 679-9001

TWX 910 325-6212

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Terminals and Printers



Z19 Video Terminal



List $995

OUR PRICE **$799**

Limited Time

Intertec

NEW INTERTUBE III

List $995 **ONLY $749**

12" display, 24 x 80 format, 18-key numeric keypad, 128 upper/lower case ASCII characters. Reverse video, blinking, complete cursor addressing and control. Special user-defined control function keys, protected and unprotected fields. Line insert/delete and character insert/delete editing, eleven special line drawing symbols.

TELEVIDEO TVI-912C



Upper and lower case, 15 baud rates: 75 to 19,000 baud, dual intensity, 24 x 80 character display, 12 x 10 resolution. Numeric pad. Programmable reversible video, auxiliary port, self-test mode, protect mode, block mode, tabbing, addressable cursor. Microprocessor controlled, programmable underline, line and character insert/delete. "C" version features typewriter-style keyboard. List $950

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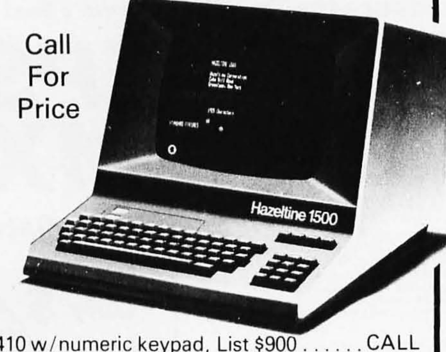
920C (with 11 function keys, 6 edit keys and 2 transmission mode keys, List $1030

CALL FOR PRICE

950C List $1195 . . . . CALL FOR PRICE

HAZELTINE 1500

Call For Price



1410 w/numeric keypad, List $900 . . . . . . CALL
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1510, List $1395 . . . . CALL
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SOROC



IQ-120
List $995
SPECIAL $729

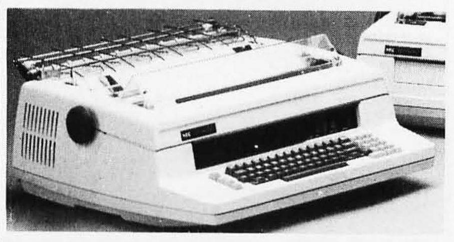
IQ135
$749

IQ-140 List $1495
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CENTRONICS PRINTERS

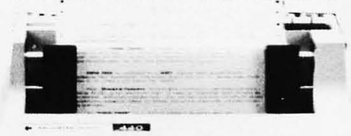
730, parallel, friction, tractor $599
NEW 739 w/graphics $819
779-2 w/tractor (same as TRS-80 Line Printer I), List $1350 . . . . $799
704-9 RS232 150CPS $1595
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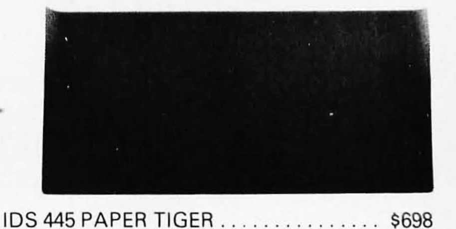
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Terminal/Keyboard as well as RO Printer Only models available.
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PAPER TIGER®



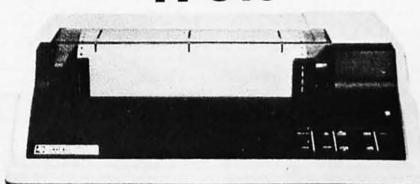


IDS 445 PAPER TIGER $698
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Buffer w/graphics option, incl. buffer . . . $789

NEW IDS 460/560
QUALITY PRINTING AT MATRIX SPEED — LOGIC SEEKING
PROPORTIONAL SPACING
w/auto test justification

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TI-810 Basic Unit, $1895 . **$1595**
TI-810 w/full ASCII (Lower case), vertical forms control, and compressed print . **$1795**
TI-820w/lower case List $1995 . . . . $1645
TI-820w/full ASCII, forms control, compressed print . . . . List $2150 . $1795
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ANADEX
DP9500/DP9501 PRINTERS
DP-9500, List $1650 . . . . **$1349**
DP-9501, List $1650 . . . . **$1349**

ANADEX DP-8000
80-Col. Dot Matrix. **$849**

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Microline 80 List $599 **ONLY** $499
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EpsonMX-80 FTList $745. . . . $599
EpsonMX-80 List$645. . . . . $499

Above prices reflect a 2% cash discount (order prepaid prior to shipment). Add 2% to prices for credit card orders, C.O.D.'s, etc. Prices are f.o.b. shipping point. Prices are subject to change and offers subject to withdrawal without notice. **WRITE FOR FREE CATALOG.**

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Computers, Disk Systems



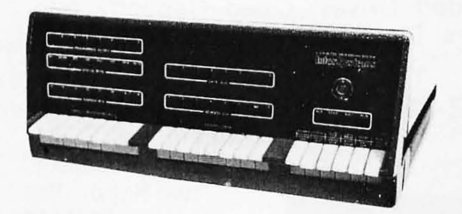


Z89-FA
List $2895
OUR PRICE
$2395

Z-89GA
List $2595, Less Disk $2149
A-87 Two Drive
Minifloppy System List $1195........ **$989**
Z-47DA........................... **$3695**
8" Two Megabyte Disk System
List $3695 .... $3059

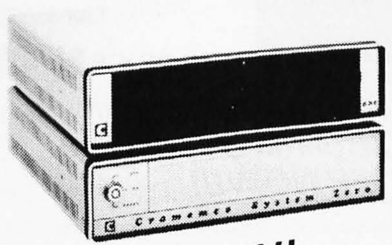
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The new Series II CPU Board features a 4 MHz Z-80A CPU and a full-feature front panel. 20-slot actively terminated motherboard, with 25 amp power supply (50/60 Hz operation, incl. 68 cfm fan). DPS-1, List $2195 CALL FOR PRICE



COMPLETE SYSTEM with InterSystem 64K RAM, I/O Board and double density disk controller board. Full 1-year warranty,

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NEW! CROMEMCO SYSTEM ZERO/D

A complete 64K Computer with Double Density Disk Controller ...... List **$2995**

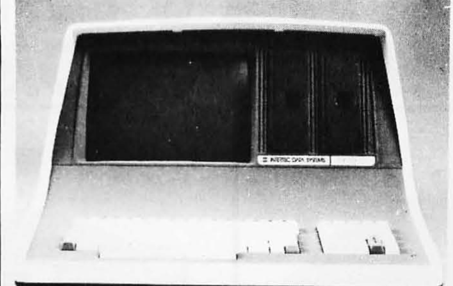
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Companion Disk drive for above — **Quad Density** — Total of 780 Kilobytes of storage on the two drives. ..... **List $1295**

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By INTERTEC



64K Double or Quad Density units available. Uses two Z-80 CPU's. Commercial-type terminal with 12" monitor. Dual double density minifloppies. Over 350 kilobytes of storage (twice that with quad density drives). Two serial RS232 ports, I/O ports standard. Expandable with optional S-100 interface. Comes with CP/MTM 2.2 operating system. MiniMicroMart can supply a wide range of CP/M development and application software.

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HP-41CV
$259.

DYNABYTE
DB 8/1



DB 8/1-64 — 64K RAM SYSTEM WITH Z80 CPU and 2 serial and 1 parallel I/O, List $3395, Disc. $2850 OUR PRICE $2795

HEWLETT PACKARD **HP-85A**
List
$3250
$2749

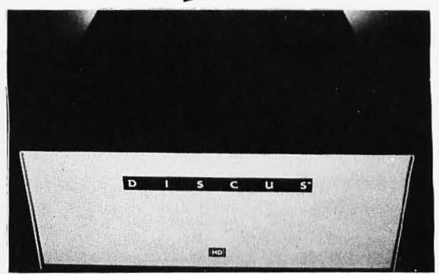


HP-83
Special $1749

F.O.B. shipping point. All prices subject to change and all offers subject to withdrawal without notice. Advertised prices are for prepaid orders. Credit card and C.O.D. 2% higher. C.O.D. may require deposit.

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THINKER TOYS®
DISCUS M26™

26 megabytes of formatted storage
List $4495
NEW LOW $3795

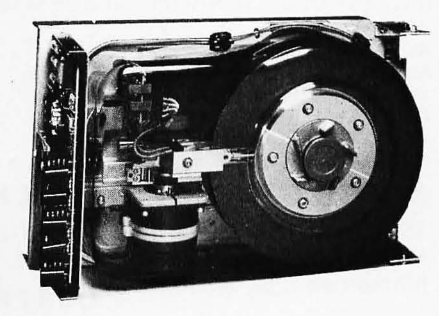


THINKER TOYS® DISK SYSTEMS
Now includes CP/M® 2.2

Discus 2D, List $1199 .... **$998**
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All Morrow floppy disks include CP/M 2.2 and Microsoft Basic 80*

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10 Megabyte
Wirchester

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OUR PRICE
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NEW! CROMIX FROM CROMEMCO
A New UNIX Like Disk Operating System,
With true multi-user, multi-tasking capabilities
List $295 .... **OUR PRICE $249**

NEW! DOUBLE DENSITY CONTROLLER BOARD FROM CROMEMCO
With built-in diagnostics
16 FDC Controller, List $595 **OUR PRICE $505**

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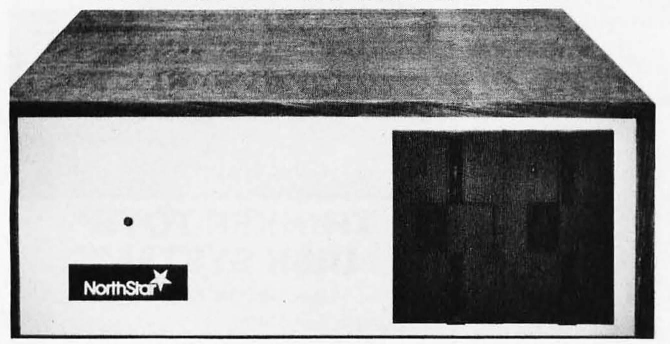
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INFOMANAGER, List $499 419
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18 megabytes, plugs into parallel port of North Star Horizon. Utilizes tried-and-proven 14" Century Data Marksman. List $4999. **OUR PRICE $4199**

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NorthStar prices going up!!!

Check by phone for prices after May 1, 1981

NEW System 3

by CROMEMCO

Now with Dual Double Sided Double Density (over 2 *megabytes* of Storage) 64K of RAM

List $7995

LIMITED TIME $6395

CROMEMCO SYSTEM 2 — Now double Density with Double Sided Drives, Quad Capacity mini floppy disc drives. List $4695 .... **Only $3899**

CROMEMCO Z-2H Full 11-megabyte Hard Disk system. Fast Z-80A 4 MHz processor, two floppy disk drives, 64K RAM memory, RS232 special interface, printer interface, and extensive software available.

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Beat the price increase on many CROMEMCO Boards & Software.
ORDER NOW!!!

NEW! Double Density Controller Board from Cromemco w/built-in diagnostics — 16 FDC Controller List $595 .... $505

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SINGLE CARD COMPUTER — SCC-W 4 MHz. List $450 .... **$382**

NEW COLOR GRAPHICS INTERFACE — SDI List $595 **OUR PRICE $505**

CROMEMCO HDD — 11/22-megabyte Hard Disk for use with existing systems. DMA controller. Transfer rate of 5.6 megabytes/second.

HDD-11, List $6995 .... **OUR PRICE ONLY $5939**
HDD-22, List $11,995 .... **$10,189**

SHIPPING AND INSURANCE: Add $15 or Horizons, $2.50 for Boards and Software. Hard Disk Systems and Cromemco systems shipped freight collect. Advertised prices are for prepaid orders. Credit card and C.O.D. 2% higher. Deposit may be required on C.O.D. All prices subject to change and offers subject to withdrawal without notice.

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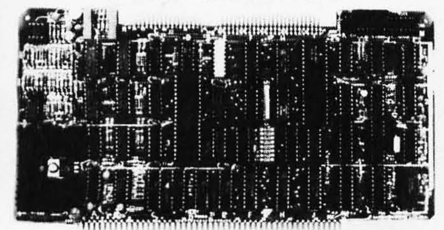
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Get the Inside Track



S-100 bus compatible • Reads and writes single or double density • Density is software selectable • CP/M® 2.2 compatible in single or double density • Controls up to four 5-1/4" or 8", single or double-sided drives • Single or double-sided drives may be mixed in the same system • On-board Z-80A to assure reliable operation • EIA level serial printer interface on board, baud rates to 9600 (perfect for despooling operations) • 2K of RAM on-board • Uses IBM standard formats • Designed to meet IEEE signal disciplines • Works with 8080, 8085, and Z-80 CPU's • 4-layer PC board with internal power and ground planes provides very stable, low-noise operation.

IOD-1200B *Bare board* **$59.95**
IOD-1200K *Kit* **$299.95**
IOD-1200A *A & T for 8"* **$375.95**
IOD-1205A *A & T for 5¼"* **$395.00**
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SFC-59002001F *CP/M 2.2 for DD* . **$150.00**

JADE

Memory Bank ™

8 or 16 Bit Dynamic Memory

New, from JADE (naturally), an IEEE S-100 64K dynamic memory that looks toward the future. • IEEE S-100 standard pinout and signal discipline • Expandable to 16 Megabytes via switchable port OR extended address lines • 8 or 16 bit words, automatically, depending on the type of CPU on the bus • 4-layer PC board for extremely low-noise operation.

The new JADE Memory Bank™ is one of the safest places you can store your valuable program information. With its on-board refresh controller, this board allows DMA operations without regard to time factors. It will run reliably at any system clock rate up to 6 MHz--because it is clocked with the system clock itself (no one-shots are used for timing operations). Its unique IEEE design enables it to switch from a 64K by 8-bit board to a 32K by 16-bit board automatically (responds to IEEE's 16 Rqst line and, if enabled, replies with 16 Grant).

On-board M1 wait-state generator allows the use of slower memory, and a unique on-board precharge extender makes this board run reliably with any manufacturer's 4116 memory chips.

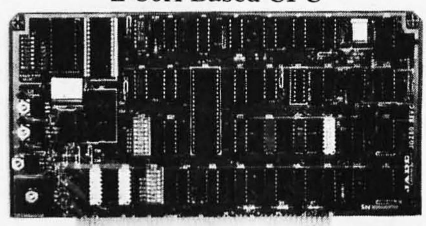
Compatible with Cromemco and other CPU systems -- features enough optional strapping to enable it to run with any Z-80/Z8000 system.

MEM-99730B *Bare Board* **$49.95**
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MEM-16730K *16K kit* **$219.95**
MEM-32731K *32K kit* **$239.95**
MEM-48732K *48K kit* **$259.95**
MEM-64733K *64K kit* **$279.95**
Assembled & Tested .... *add* **$50.00**

JADE

The Big Z ™

Z-80A Based CPU



S-100 bus compatible • Switch selectable 2 or 4 MHz operation • Serial I/O port • Accomodates a 2708, 2716, or 2732 EPROM in shadow mode allowing full use of 64K RAM • MWRITE signal is generated automatically if used without front panel • On-board 8251 USART controls serial port at baud rates from 75 to 9600 baud • Switch selectable 1K, 2K, or 4K boundary fully buffered • Power-on jump to EPROM

CPU-30201K *Kit* **$139.95**
CPU-30201A *A & T* **$189.95**
CPU-30200B *Bare board* **$35.00**

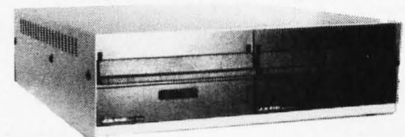
Memory Chips on Sale

	1-9	10-24	25-49	50+
2114L *4 MHz*	3.35	2.99	2.75	2.49
2708 *2 MHz*	4.90	3.90	3.45	2.90
2532 *2 MHz*	24.90	19.90	15.90	12.90
2716 *2 MHz*	8.90	7.45	6.45	5.75
2716 *4 MHz*	19.90	15.45	13.45	11.75
2732 *2 MHz*	24.90	19.90	15.90	12.90
2732 *4 MHz*	39.90	29.90	24.90	19.90
2758 *2 MHz*	6.90	6.25	5.50	4.50
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4164 *200 ns*	28.90	24.90	22.90	19.90

JADE

Disk Sub-Systems

Shugart, Siemens, Qume



Handsome metal cabinet with proportionally balanced air flow system • Rugged dual drive power supply • Power cable kit • Power switch, line cord, fuse holder, cooling fan • Never-Mar rubber feet • All necessary hardware to mount 2-8" disk drives, power supply, and fan • Does not include signal cable

Dual 8" Subassembly Cabinet

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END-000431 *A & T* **$359.95**

8" Disk Drive Subsystems
Single Sided, Double Density

END-000423 *Kit w/2 FD100-8Ds* .. **$975.00**
END-000424 *A & T w/2 FD100-8Ds* **$1175.00**
END-000433 *Kit w/2 SA-801Rs* ... **$999.95**
END-000434 *A & T w/2 SA-801Rs* **$1195.00**

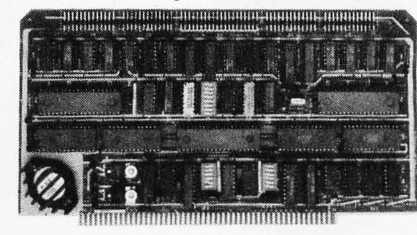
8" Disk Drive Subsystems
Double Sided, Double Density

END-000426 *Kit w/2 DT-8s* **$1475.00**
END-000427 *A & T w/2 DT-8s* ... **$1675.00**
END-000436 *Kit w/2 SA-851Rs* .. **$1495.00**
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S.P.I.C.

Our "SPICy" New I/O Board



New, from JADE, one of the most advanced, technologically sophisticated Serial/Parallel Interrupt Controller systems in the world. On a single IEEE S-100 standard board, JADE has packed two bi-directional parallel ports with full handshaking, four serial channels (asynchronous, IBM-compatible bi-synch, synchronous, HDLC/SDLC) with complete modem control lines, and 16 counter-timer channels.

Utilizing the highly advanced Zilog peripheral chips, (Z-80 SIO, PIO & CTCs), the SPIC board is fully programmable to serve as the foundation for a multi-user multi-tasking system. Although the board can be operated in an 8080/8085 system, we recommend its use with a Z-80/Z8000 system utilizing the powerful Z-80/Z8000 interrupt Mode 2. Each of the seven Z-80 peripheral chips can generate its own interrupt vector, with daisy-chain priority levels. Each counter-timer channel can be programmed to monitor an interrupt vector line on the S-100 bus, to serve as an interval timer or real-time clock, and to operate as a software controllable baud rate generator. Each SIO channel can be driven independently with separate Tx/Rx clocks for each channel, so your peripherals can have varied baud rates, from 110 to 76,800 baud

In addition, this board can serve as a data concentrator link to an IBM, DEC, or Data General mainframe computer, utilizing a high-speed serial channel that is programmable to virtually any protocol.

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IOI-1045K *Kit, standard* **$179.95**
IOI-1045A *A & T, standard* **$239.95**
IOI-1046K *Kit w/full chip set* **$219.95**
IOI-1046A *A & T w/full chip set* ... **$299.95**

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Now, for the first time, at an amazingly low price, CP/M and SDOS users can get an affordable business software package. Just look at these programs! All come complete with basic code (written to run under CBASIC I), for easy customizing and modification. All software is self-documenting. The package price includes a word-processing system. When printed on the system's printer, all files with the extension xxxTOT. constitute a complete manual. No manuals are supplied with the package other than as they appear on the disks. All software is supplied on 8" premium quality JADE Diskettes. Software sold as is. (Sorry, but at these low prices we can not offer our usual friendly support and handholding.)

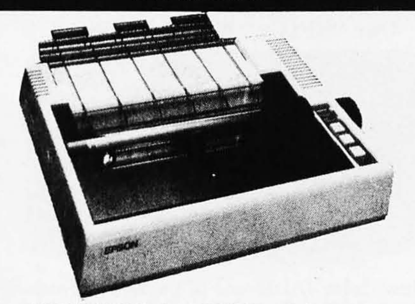
Includes; General Ledger, Payroll, Invoicing, Inventory Controll, Accounts Recievable, Cash Disbursements, Fixed Assets, Cash Receipts, & Mailing List Management.

Special Package Price ***$249.95***

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Lower Prices,

Printers



BEST BUY in PRINTERS - Epson

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PRM-27070 *List $459* $399.95

MX-80 *132 column, 80 CPS, bi-directional/logic seeking printing, 9 x 9 dot matrix, adjustable tractor feed, & 64 graphics characters*
PRM-27080 *List $645* $474.95

MX-80FT *same as MX-80 with friction feed and full graphics added*
PRM-27082 *List $745* $574.95

MX-100 *233 column, correspondence quality, ultra-high resolution graphics, up to 15" paper, friction feed & removable/adjustable tractor feed, 18 x18 dot matrix, 80 CPS, programmable forms handling*
PRM-27100 *List $945* $795.00

PRA-27084 *Serial interface* $69.95
PRA-27088 *Serial intf & 2K buffer* .. $144.95
PRA-27081 *Apple card* $74.95
PRA-27082 *Apple cable* $22.95
PRA-27086 *IEEE 488 card* $52.95
PRA-27087 *TRS-80 cable* $32.95
PRA-27085 *Graftrax II* $95.00
PRA-27083 *Extra ribbon* $14.95

SPINWRITER - NEC

65 cps, bi-directional, letter quality printer with deluxe tractor mechanism, both parallel and serial interfaces on-board, 16K buffer, ribbon, print thimble, graphics, micro-space justification, data cable, and self test/diagnostic ROM.
PRD-55511 *without 16K buffer* ... $2795.00
PRD-55512 *with 16K buffer* $2895.00

Accessories for TRS-80

DISK DRIVES for TRS-80

23% more storage, 8 times faster, 40 track with free patch, 120 day warranty.
MSM-12410C *Save $125.00 !!!* $325.00

8" DISK DRIVES for MODEL II

2 double density drives with cabinet, power supply, & cables
END-000433 *Kit* $1050.00
END-000434 *Assembled* $1250.00
WCA-5036A *Cable (required)* $29.95

16K Atari ... $359.95

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Complete personal computer with high resolution color graphics, built-in RF modulator, 4 controller ports, internal speaker, 16K RAM & 8K ROM
SYO-2080A *16K Atari 800* $759.95
Atari 800 with 32K of RAM $799.95
Atari 800 with 48K of RAM $849.95
SYO-2040A *16K Atari 400* $359.95
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MSM-330815 *Dual drive* $1395.00
IOX-5050A *850 interface* $199.95
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Accessories for Apple



16K MEMORY UPGRADE

Add 16K of RAM to your TRS-80, Apple, or Exidy in just minutes. We've sold thousands of these 16K RAM upgrades which include the appropriate memory chips (as specified by the manufacturer), all necessary jumper blocks, fool-proof instructions, and our 1 year guarantee.
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MEX-16101K *Apple kit* $25.00
MEX-16102K *Exidy kit* $25.00

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(There is life after 48K)
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Two computers in one, Z-80 & 6502, more than doubles the power & potential of your Apple, includes Z-80 CPU card, CP/M 2.2, & BASIC-80*
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Real time clock w/battery back-up
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DISK DRIVE for APPLE

5¼" disk drive with controller for your Apple
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MSM-123101 *w/out controller* $375.00

8" DRIVES for APPLE

Controller, DOS, two 8" double densisty drives, cabinet, power supply, & cables
Special Package Price *Kit* $1399.95

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IOI-2041A *A & T* $99.95

AIO, ASIO, APIO - S.S.M.

Parallel & serial interface for your Apple (see Byte pg 11)
IOI-2050K *Par & Ser kit* $139.95
IOI-2050A *Par & Ser A & T* $169.95
IOI-2052K *Serial kit* $89.95
IOI-2052A *Serial A & T* $99.95
IOI-2054K *Parallel kit* $69.95
IOI-2054A *Parallel A & T* $89.95

A488 - S.S.M.

IEEE 488 controller, uses simple basic commands, includes firmware and cable, 1 year guarantee, (see April Byte pg 11)
IOX-7488A *A & T* $399.95

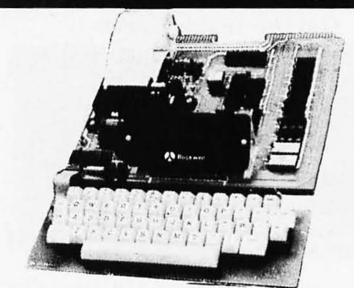
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Three cards in one! Real time clock/calendar, serial interface, & parallel interface - all on one card.
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VISICALC - Personal Sftwr

The ultimate program for your Apple II
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Single Board Computers



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6502 computer with alphanumeric display, printer, & keyboard, and complete instructional manuals
CPK-50165 *1K AIM* $424.95
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SFK-74600008E *8K BASIC ROM* ... $99.95
SFK-64600004E *4K assembler ROM* $84.95
PSX-030A *Power supply* $64.95
ENX-000002 *Enclosure* $54.95
4K AIM, 8K BASIC, power supply, & enclosure
Special package price $675.00

Z-80* STARTER KIT - SD Systems

Complete Z-80 computer with RAM, ROM, I/O, display, keyboard, manual, and kluge area.*
CPS-30010K *Kit* $369.95
CPS-30010A *A & T* $459.95

SYM-1 - Synertek Systems

Single board computer with 1K of RAM, 4K of ROM, key-pad, LED display, 20ma & cassette interface on board.
CPK-50020A *A & T* $249.95

Video Terminals

VIEWPIONT - ADDS

Detachable keyboard, serial RS232C interface, baud rates from 110 to 19,200, auxiliary serial output port, 24 x 80 display, tiltable screen, international character set
VDT-501210 *Sale Priced* $639.95

TELEVIDEO 950

Detachable keyboard, split screen with line lock, etched CRT, programmable function keys, on-screen status line, buffered auxiliary port, 14 x 10 dot matrix, self test, serviced nation-wide by General Electric
VDT-901250 *List $1195.00* $995.00

Video Monitors

Leedex / Amdek

Reasonably priced video monitors
VDM-801210 *Video 100 12" B&W* .. $149.95
VDM-801230 *Video 100-80 12" B& W* $189.95
VDM-801250 *12" Green Phospor* $189.95
VDC-801310 *13" Color I* $399.95

13" COLOR MONITOR - Zenith

The hi res color you've been promising yourself
VDC-201301 .... $449.00

12" GREEN SCREEN - NEC

20 MHz, P31 phosphor video monitor with audio, exceptionally high resolution - A fantastic monitor at a very reasonable price
VDM-651200 *12" monitor* $259.95

EPROM Erasers

EPROM ERASERS

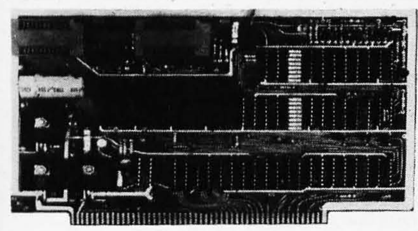
L.S. Engineering UV eraser for up to 48 EPROMs
XME-3200 *A & T* $39.99

Spectronics hi intensity industrial eraser
XME-3100 *Without timer* $69.50
XME-3101 *With timer* $94.50

Circle 182 on inquiry card.

Faster Service.

S-100 PROM Boards



PB-1 - S.S.M.
2708, 2716 EPROM board with built-in programmer

MEM-99510K *Kit* $154.95
MEM-99510A *A & T* $219.95

PROM-100 - SD Systems
2708, 2716, 2732, 2758, & 2516 EPROM programmer

MEM-99520K *Kit* $219.95
MEM-99520A *Jade A & T* $269.95

EPROM BOARD - Jade
16K or 32K uses 2708's or 2716's, 1K boundary

MEM-16230K *Kit* $79.95
MEM-16230A *A & T* $119.95

S-100 Video

VB-3 - S.S.M.
80 characters x 24 lines expandable to 80 x 48 for a full page of text, upper & lower case, 256 user defined symbols, 160 x 192 graphics matrix, memory mapped, has key board input.

IOV-1095K *4 MHz kit* $349.95
IOV-1095A *4 MHz A & T* $439.95
IOV-1096K *80 x 48 upgrade* $39.95

VDB-8024 - SD Systems
80 x 24 I/O mapped video board with keyboard I/O, and on-board Z-80A.*

IOV-1020K *Kit* $399.95
IOV-1020A *Jade A & T* $459.95

VIDEO BOARD - Jade
64 characters x 16 lines, 7 x 9 dot matrix, full upper/lower case ASCII character set, numbers, symbols, and greek letters, normal/reverse/blinking video, S-100.

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IOV-1050A *A & T* $125.00
IOV-1050B *Bare board* $29.95

Motherboards

ISO-BUS - Jade
Silent, simple, and on sale - a better motherboard

6 Slot (5¼" x 8⅝")

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MBS-121B *Bare board* $29.95
MBS-121K *Kit* $69.95
MBS-121A *A & T* $89.95

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MBS-181K *Kit* $99.95
MBS-181A *A & T* $139.95

Mainframes

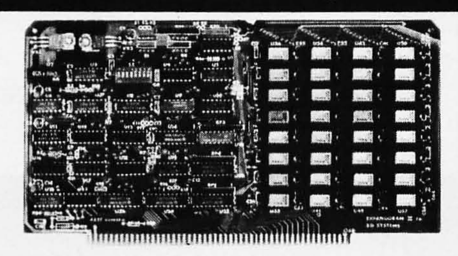
MAINFRAME - Cal Comp Sys
12 slot S-100 mainframe with 20 amp power supply

ENC-112105 *Kit* $379.95
ENC-112106 *A & T* $409.95

DISK MAINFRAME - N.P.C.
Holds 2 8" drives and a 12 slot S-100 system. Attractive metal cabinet with 12 slot motherboard & card cage, power supply, dual fans, lighted switch, and other professional features

ENS-112320 *with 25 amp p.s.* $699.95

S-100 Memory



EXPANDORAM II - S D Systems
4 MHz RAM board expandable from 16K to 64K

MEM-16630K *16K kit* $275.95
MEM-32631K *32K kit* $295.95
MEM-48632K *48K kit* $315.95
MEM-64633K *64K kit* $335.95
Assembled & tested .... add $50.00

64K RAM - Calif Computer Sys
4 MHz bank port / bank byte selectable, extended addressing, 16K bank selectable, PHANTOM line allows memory overlay, 8080 / Z-80 / front panel compatible.

MEM-64565A *A & T* $575.00

32K STATIC RAM - Jade
2 or 4 MHz expandable static RAM board uses 2114L's

MEM-16151K *16K 4 MHz kit* $169.95
MEM-32151K *32K 4 MHz kit* $299.95
Assembled & tested .... add $50.00

16K STATIC RAM - Mem Merchant
4 MHz 16K static RAM board, IEEE S-100, bank selectable, Phantom capability, addressable in 4K blocks, "disable-able" in 1K segments, extended addressing, low power

MEM-16171A *A & T* $174.95

S-100 Disk Controller

DOUBLE DENSITY - Cal Comp Sys
5¼" and 8" disk controller, single or double density, with on-board boot loader ROM, and free CP/M 2.2 and manual set.*

IOD-1300A *A & T* $369.95

VERSAFLOPPY II - SD Systems
New double density controller for both 8" & 5¼"

IOD-1160K *Kit* $339.95
IOD-1160A *A & T* $379.95

Disk Drives

8" DISK DRIVES
Highly reliable double density floppy disk drives

Shugart 801R single sided, double density

MSF-10801R *SA-801R* $425.00
Special Sale Price .... **2 for $790.00**

Shugart 851R double sided, double density

MSF-10851R *SA-851R* $595.00
Special Sale Price .... **2 for $1150.00**

Siemens FDD100-8D2 single sided, double density

MSF-201120 *6 mo warranty* $385.00
Special sale price .... **2 for $750.00**

Qume Datatrak 8 double sided, double density

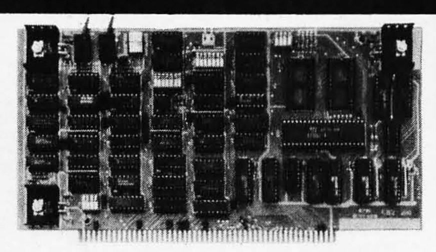
MSF-750080 *SA-851R compatible* .. $599.95
Special sale price .... **2 for $1160.00**

JADE DISK PACKAGE
Double density controller, two 8" double density floppy disk drives, CP/M 2.2 (configured for controller), hardware and software manuals, boot PROM, cabinet, power supply, fan, & cables

Special Package Price *Kit* $1395.00

5¼" Diskettes *Box of 10* .. $22.00
8" Diskettes *Box of 10* $24.00

S-100 CPU



CB-2 Z-80 CPU - S.S.M.
2 or 4 MHz Z-80 CPU board with provision for up to 8K of ROM or 4K of RAM on board, extended addressing, IEEE S-100, front panel compatible.

CPU-30300K *Kit* $239.95
CPU-30300A *A & T* $299.95

2810 Z-80* CPU - Cal Comp Sys
2/4 MHz Z-80A CPU with RS-232C serial I/O port and on-board MOSS 2.2 monitor PROM, front panel compatible.*

CPU-30400A *A & T* $269.95

SBC-200 - SD Systems
4 MHz Z-80 CPU with serial & parallel I/O ports, up to 8K of on-board PROM, software programmable baud rate generator, 1K of on-board RAM, Z-80 CTC.*

CPC-30200K *Kit* $339.95
CPC-30200A *Jade A & T* $399.95

S-100 I/O

I/O-4 - S.S.M.
2 serial I/O ports plus 2 parallel I/O ports

IOI-1010K *Kit* $179.95
IOI-1010A *A & T* $249.95
IOI-1010B *Bare board* $35.00

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(We have only 265 availible at this special price)

IOM-5200A *List price $189.95* $139.95

D-CAT 300 baud, direct connect modem

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2 YEAR WARRANTY

EXCLUSIVE ACOUSTIC CHAMBERS

The exclusive triple seal of Livermore's new flat mounted cups locks the handset into the acoustic chamber yielding superior acoustic isolation and mechanical cushioning. Designed to adapt to most common handsets used throughout the world, the STAR offers the utmost in flexibility and transmission reliability.

Specifications:

- **Data Rate:** 0 to 300 baud
- **Compatibility:** Bell 103 and 113; CCITT
- **Frequency Stability:** ±0.3 percent. Crystal controlled
- **Receiver Sensitivity:** −50 dBm ON, −53 dBm OFF
- **Modulation:** Frequency shift keyed (FSK)
- **Carrier Detect Delay:** 1.2 seconds ON; 120 msec OFF
- **EIA Terminal Interface:** Compatible with RS 232 specifications
- **Teletype Interface:** 20 milliampere current loop
- **Optional Interfaces:** IEEE 488; TTL; TTY 43
- **International (CCITT) frequencies available**
- **Switches:** Originate/Off/Answer; Full Duplex/Test/Half Duplex
- **Indicators:** Transmit Data, Receive Data, Carrier Ready, Test
- **Power:** Supplied by 24 VAC/150 MA UL/CSA listed wall-mount transformer. Input 115 VAC, 2.5 watts. (A 220 VAC, 50 Hz adaptor is available upon request.)
- **Dimensions:** 10″ x 4″ x 2″
- **Weight:** 1.74 lbs. (3 lbs. shipping weight including AC adaptor.)
- **Warranty:** Two years on parts and labor, excluding the AC adaptor which carries the manufacturer's warranty

Part No.	Description	List Price	SALE PRICE
LIV-STAR	RS232, TTL, 20 MA Current Loop	$199.00	$129.00

CABLES

Part No.	Description	Price
CND-RS2328F	RS232 8 Cond 8 ft.	$19.95

RS232 and "D" SUB-MINIATURE CONNECTORS

MALE — FEMALE

P = Plug, Male Type - S = Socket, Female Type - C = Cover, Hood

PART NO.	DESCRIPTION	PRICE 1-9	10-24	25-99
CND-DE9P	9 PIN MALE	$ 2.10	$ 1.90	$ 1.70
CND-DE9S	9 PIN FEMALE	$ 2.70	$ 2.40	$ 2.10
CND-DE9C	9 PIN COVER	$ 1.50	$ 1.25	$ 1.10
CND-DA15P	15 PIN MALE	$ 2.75	$ 2.45	$ 2.15
CND-DA15S	15 PIN FEMALE	$ 3.95	$ 3.60	$ 3.20
CND-DA15C	15 PIN COVER	$ 1.50	$ 1.30	$ 1.10
CND-DB25P	25 PIN MALE	$ 3.00	$ 2.75	$ 2.60
CND-DB25S	25 PIN FEMALE	$ 4.00	$ 3.75	$ 3.50
CND-DB51212	1 PC. GREY HOOD	$ 1.60	$ 1.45	$ 1.30
CND-P25H	2 PC. GREY HOOD	$ 1.50	$ 1.25	$ 1.10
CND-DB51226	2 PC. BLACK HOOD	$ 1.90	$ 1.65	$ 1.45
CND-DC37P	37 PIN MALE	$ 5.80	$ 5.10	$ 4.45
CND-DC37S	37 PIN FEMALE	$ 8.70	$ 7.70	$ 6.70
CND-DC37C	37 PIN COVER	$ 1.80	$ 1.55	$ 1.30
CND-DD50P	50 PIN MALE	$ 8.75	$ 7.75	$ 6.70
CND-DD50S	50 PIN FEMALE	$11.65	$10.25	$ 8.90
CND-DD50C	50 PIN COVER	$ 2.00	$ 1.80	$ 1.60
CND-D20418	HARDWARE SET 2 PR.	$ 1.00	$ 0.80	$ 0.70
CND-RS2328F	RS232, DB25P, EIA CLASS 1 CABLE 8 CON. 8 FT.	$19.95	$17.95	$15.95
CND-5730360	CENT. 700 SERIES PRINTER CONNECTOR	$ 9.00	$ 7.50	$ 6.00

GOLD S-100 CONNECTORS

SOLDER TAIL PRICE

Part No.	1-9	10-24	25-99	100-249
S100 STG	3.50	3.20	2.80	2.50

WIRE WRAP PRICE

Part No.	1-9	10-24	25-99	100-249
S100 WWG	4.00	3.75	3.50	3.25

2708 $8.50 EA. 8/$32.00

450ns 8K EPROM

2716 $11.95 EA 8/$48.00

450ns 5-Volt only 16 K EPROM

2114-3L

4096 BIT (1024x4) 300ns LOW POWER STATIC RAM

8/$30.00

100 + $3.00

2016P3

2K x 8 200ns L/P STATIC RAM

8/$100.00

TRS-80/APPLE

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4116's RAMS

from Leading Manufacturers

(16Kx1 200ns)

100% GUARANTEED — 1,000's SETS SOLD

8 for $24.00

ADD $3.00 FOR PROGRAMMING JUMPERS FOR TRS-80 KEYBOARD

4116's 100 pcs & UP $2.75 each

1000 pcs & UP $2.50 each

POWERLINE INSOLATOR



GOF-IBARW3

SH. WT. 3 LBS.

LIST PRICE $59.95

SALE PRICE $29.95

A MUST FOR EVERY OFFICE WITH DATA PROCESSING EQUIPMENT

PROTECT YOUR INVESTMENT PROTECT YOUR DATA WITH

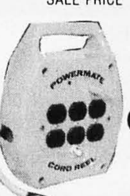


GOF-IBAR46

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- Sockets individually filter isolated
- Each socket isolated from power line

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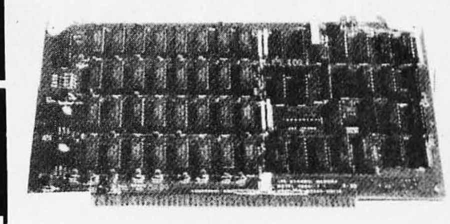
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- SIX GROUNDED 3-PRONG OUTLETS!
- CIRCUIT BREAKER FOR SAFETY'S SAKE — GUARDS AGAINST OVERLOADS ABOVE 10 AMPS

GOF-CR21 22 Ft. - 5 lbs. $24.95

GOF-CR50 50 ft. - 10 lbs. $39.95

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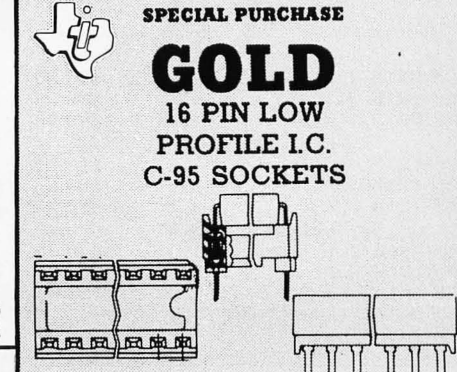
THE UNIVERSAL IEEE-S100 DYNAMIC MEMORY CARD

THE EXPANDALBE 1 TM 64K Dynamic Ram board provides your S-100 system with 64K of reliable, high-speed dynamic RAM. Compatible with most of the major S-100 systems on the market, including those with front panels, it supports DMA operations and requires no Wait states with current microprocessors.

- *User expandable from 16 to 64 K*
- *2 or 4 MHz operation*
- *North Star compatible*
- *Cromemco Compatible*
- *Designed to IEEE proposed S-100 bus standards*
- *Supports IMSAI-type front panels*
- *Operates with either an 8080 or Z-80 based S-100 system, providing processor-transparent refreshes with both*
- *Bank-select system allows system memory expansion and is compatible with Cromemco products*
- *Bank select port's address is jumper selectable*
- *Any 16K block can be made bank-independent*
- *All 64K can be made bank-enabled on power-on and reset*
- *Configuration as a 16K, 32K, or 48K board without the removal of RAMs*
- *Fully buffered address and data lines*
- *Fail-safe refresh circuitry for extended Wait states*
- *Board configuration with reliable, easy-to-configure Berg jumpers*
- *Supports DMA*
- *Jumper-selectable Phantom input*
- *Uses Popular 4116 RAMS*
- *Assembled & tested*
- *All ICs in sockets*
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- *FR-4 glass epoxy*
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PRI-EXP1-16 $299.00

Factory Assembled and Tested 16K Board. For additional memory order 1 set of 8 4116's at the left for each additional 16K. ***PRIORITY ONE ELECTRONICS*** can supply the board A&T populated to 32K, 48K, or 64K at additional cost, see our catalog or call for pricing.



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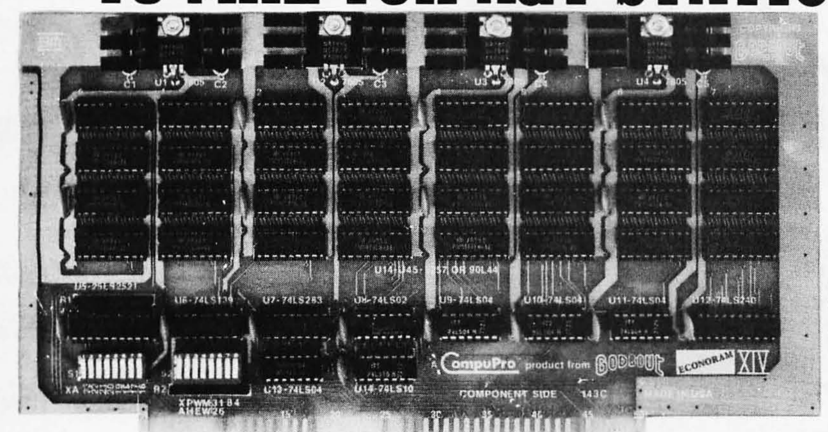
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GBT-143A
List
$349.00



$169.00

or 3 for $450.00

The **RAM 14** provides 16K X 8 of reliable, totally static RAM storage. Conforming fully to the IEEE 696/S-100 bus standard, **RAM 14** not only provides 24 address lines for 16 megabyte extended addressing capability, but also includes a number of features you would only expect to find in memory boards costing considerably more. Here's a partial listing of what makes **RAM 14** your best choice!

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- Low power operation (900 mA typical, 1200 mA maximum).
- 1 year Factory Warranty.

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S-100 CPU

CPU-Z - GODBOUT
2/4 MHZ Z80 CPU 24 Bit Addressing

GBT 160U	UnKit	$225.00
GBT 160A	A&T	$280.00
GBT 160C	CSC 3-6 MHZ	$375.00

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5 MHZ Provides true 16 Bit Power with a standard 8 bit S-100 bus

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GBT 1612C	CSC	$498.00

BOARD WITH 8085 ONLY

GBT 161U	UnKit	$235.00
GBT 161A	A&T	$305.00
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2810 Z80 CPU-CA. COMP. SYST.
2/4 MHZ Z80A CPU with RS-232C Serial I/O Port complete with Monitor PROM for 2422 Disk Controller

CCS 2810	A&T	$280.00

CB2 Z80 CPU - S.S.M.
2/4 MHZ will accept 2716, or 2732, or RAM RUN/STOP and single step switches

SSMCB2K	Kit	$260.00
SSMCB2A	A&T	$310.00
SSMZ80M	SSM Z80 Monitor	$89.00

CBIA 8080 CPU - S.S.M.
8080CPU, 1K RAM, Holds 1 2708, 1 8 Bit parallel input port.

SSMCB1A	Kit	$183.00
SSMCB1A	A&T	$225.00
SSM8080M	SM 8080 Monitor	$59.00

S-100 RAM

64K STATIC RAM - GODBOUT
RAM 17, 10 MHZ, 2 Watt, DMA Compatable

GBT-175A48	A&T 48K	$950.00
GBT-175C48	CSC 48K	$1050.00
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GBT-175C64	CSC 64K	$1395.00

64K DYNAMIC RAM - CCS
4 MHZ, on board refresh, DMA compatable, 24 bit address.

CCS-2065A	A&T	$599.00

32K STATIC RAM - GODBOUT
RAM 20 10 MHZ, 4K byte block disable, available 16, 24, or 32K

GBT-164A16	A&T 16K	$319.00
GBT-164C16	CSC 16K	$418.00
GBT-164A24	A&T 24K	$449.00
GBT-164C24	CSC 24K	$539.00
GBT-164A32	A&T 32K	$499.00
GBT-164C32	CSC 32K	$720.00

32K STATIC RAM - CCS
4 MHZ, Bank select, 8/16 bit data

CCS-2032	A&T 32K	$599.00

16K STATIC RAM - GODBOUT
RAM 14, 10 MHZ, 24 bit addressing

GBT-143A	A&T 16K	$199.00
GBT-143C	CSC 16K	$399.00

16K STATIC RAM - CCS
4 MHZ, 8/16 bit data, bank select

CCS-2116A	A&T 16K	$299.00

8K STATIC RAM - GODBOUT
Econoram II 2MHZ, 8K, No doubt, the most popular S-100 RAM ever built.

GBT-114U	UnKit 8K	$99.95

S-100 ROM

PB1 PROM PROGRAMMER - SSM
programs 2708 or 2716's, operates as a 4K/8K EPROM board as well.

SSM-PB1K	Kit	$179.00
SSM-PB1A	A&T	$239.00

ECONOROM 2708 - GODBOUT
16K x 8 EPROM Board using 2708, Power on jump to any 256 byte

GBT 125U	UnKit	$85.00
GBT 125A	A&T	$120.00
GBT 125C	CSC	$175.00

S-100 DISK CONTROLLERS

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DMA, Soft Sector, Controls 8" or 5¼", single or double density

GBT 171A	A&T	$450.00
GBT 171C	CSC	$555.00
GBT CPM80	CP/M 2.2 for Z80/8085 with Manuals & BIOS 8" S.D. disk	$175.00
GBT CPM86	CP/M for 8086 with manuals & BIOS 8" S/D disk	$300.00

2422A - CA. COMP. SYST.
I/O Mapped, controls 8" or 5¼", single or double density

CCS-2422	A&T with CPM 2.2 8" S.D.	$375.00

DISK JOCKEY 1 - MORROW
Single density disk controller with serial I/O, controls 8"

MDSDJ1108	A&T	$219.00

DISK JOCKEY 2D - MORROW
I/O Mapped, controls 8", single or double density, serial I/O

MDSDJ2208	A&T	$375.00

DISK DRIVES

801R - SHUGART
Single sided double density most popular 8" drive

SHU801R	$425.00 ea. or 2 or more	$410.00
SHUSA801RM	Manual for 801R drives	$10.00

DT-8 - QUME
Data track 8 double sided, double density

QME-DT8	$625.00 ea. or 2 or more	$600.00 ea.

DISK CABINETS

V-100 - VISTA
Dual 8" drive cabinet with power supply. Rack or Desk Mount

VIS-V100	$395.00

SINGLE 8" - Q.T.
Single 8" cabinet with power supply

QTC-DDC8	$195.00

5" CABINETS - VISTA

VIS-9801	Single 5" with P.S.	$75.00
VIS-9802	Dual 5" with P.S.	$95.00

S-100 DISK SUBSYSTEMS

DISCUS SINGLE SIDES MORROW
8" DBL Density drives with cabinet, power supply controller, with CP/M 2.2 and Microsoft Basic

MDSF1218	Single Drive System	$950.00
MDSF1228	Dual Drive System	$1598.00

DISCUS DOUBLE SIDED - MORROW
8" DBL Density/sided drives with cabinet Power supply controller, with CP/M 2.2 and Microsoft Basic

MDSF2218	Single Drive System	$1198.00
MDSF2228	Dual Drive System	$2190.00

26MB HARD DISK - MORROW

Special purchase, limited stock - 26MB formatted hard disk complete with cabinet, P.S., Controller, CPM 2.2 and Microsoft Basic

MDS-M26S	26 MB Subsystem List	$4995.00

SALE
★ $3950.00 ★
SAVE $1,045.00!
MICROPOLIS

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S-100 I/O BOARDS

SYSTEM SUPPORT 1 - GODBOUT
Serial port (software prog baud), 4K EPROM or RAM provision, 15 levels of interrupt, real time clock, optional math processor

GBT-162U	UnKit	$295.00
GBT-162A	A&T	$360.00
GBT-162C	CSC	$460.00
GBT-9512	Math Chip	$195.00

MPX CHANNEL BOARD - GODBOUT
I/O Multiplexer, using 8085A-2 cpu on board

GBT-166A	A&T	$450.00
GBT-166C	CSC	$550.00

INTERFACER I - GODBOUT
Two Serial I/O

GBT-133A	A&T	$219.00
GBT-133C	CSC	$298.00

INTERFACER II - GODBOUT
Three parallel, one serial I/O board

GBT-150A	A&T	$219.00
GBT-150C	CSC	$298.00

MULTI I/O - MORROW DESIGNS
Three Serial, Two parallel

MDSMB3200	A&T	$309.00

SWITCHBOARD-MORROW DESIGNS
Two serial I/O, four parallel I/O, one status port, one strobe port

MDSSB2411	A&T	$239.00

I/O2 - SSM
One parallel input, one parallel output, proto work area

SSMI02K	Kit	$69.00
SSMI02A	A&T	$89.00

I/O4 - SSM
Two serial I/O, two parallel I/O

SSMI04K	Kit	$210.00
SSMI04A	A&T	$260.00

SBI-SSM
Music synthesizer board

SSMSBIK	Kit	$249.00
SSMSBIA	A&T	$310.00
SSMSBIS	Software	$ 25.00

S-100 VIDEO BOARDS

SPECTRUM - GODBOUT
Color Graphics board with Parallel I/O.

GBT-1440	UnKit	$299.00
GBT-144A	A&T	$349.00
GBT-2D	Sublogic Software	$ 35.00

VB - 3 S.S.M.
80 x 24 or 48 character video display Memory Mapped, Parallel Keyboard port

SSM-VB3K24	Kit 80x24	$359.00
SSM-VB3A24	A&T 80x24	$450.00
SSM-VB3K48	Kit 80x48	$425.00
SSM-VB3K48	A&T 80x48	$495.00
SSM-VB3UP	Upgrade Kit	$ 50.00

VB2 - SSM
I/O Mapped Video Board, with Parallel Keyboard port. 64x16

SSM-VB2K	Kit	$169.00
SSM-VB2A	A&T	$229.00

VBIC - SSM
Memory Mapped Video Board 64x16 character display or 64x16 graphics dislplay

SSM-VBICK	Kit	$169.00
SSM-VBICA	A&T	$229.00

S-100 MOTHERBOARDS

MOTHERBOARD - GODBOUT
Active termination, 6-12-20 slot

GBT-153U	Unkit 6 slot	$ 89.00
GBT-153A	A&T 6 slot	$119.00
GBT-154U	Unkit 12 slot	$129.00
GBT-154A	A&T 12 slot	$149.00
GBT-155U	Unkit 20 slot	$174.00
GBT-155A	A&T 20 slot	$189.00

WUNDERBUSS - MORROW DESIGNS
Active termination, 8-12-20 slot, peripheral power outputs (5V@1A, 12V @ 500ma, −12V @ 500ma)

MDS0800K	Kit 8 slot no connectors	$ 54.00
MDS1200K	Kit 12 slot no connectors	$ 65.00
MDS2000K	Kit 20 slot no connectors	$ 76.00
MDS0800A	A&T 8 slot	$129.00
MDS1200A	A&T 12 slot	$149.00
MDS2000A	A&T 20 slot	$199.00

S-100 MISC.

CK017 ACTIVE TERMINATOR-GODBOUT

GBT-106U	Kit	$ 34.95

2520 - CCS
Extender/terminator, Active and/or passive

CCS2520AK	Kit	$ 59.00

EXTENDER/LOGIC PROBE-MULLEN

MUL-CK004	Kit	$ 59.00

OB1 VECTOR JUMP - SSM
with prototyping area

SSM-OB1K	Kit	$ 65.00
SSM-OB1A	A&T	$ 90.00

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CompuPro™ division of **GODBOUT ELECTRONICS**

TEAMS UP WITH PRIORITY ONE ELECTRONICS TO INTRODUCE THE NEXT GENERATION OF IEEE/696 S-100 COMPUTERS

8 BIT

There are still a lot of 8 bit machines out in the world, matched with plenty of 8 bit software — but very few of these machines are working up to their peak capacity. We want the "Big 8" system to change all that, and bring professional level computing power to all the owners of older S-100 machines. And if you're assembling an 8 bit system from the ground up, "Big 8" gets you off to the best possible start . . . regardless of price.

Here's what you get

1. CPU Z, our high speed, high performance Z80* based CPU board. Includes a 6 MHz CPU for maximum throughput and highest operating speed.
2. Disk 1 DMA floppy disk controller.
3. 64K of *fast* static RAM with 24 bit extended addressing.
4. Interfacer 1 — Dual Serial I/O card *or* Interfacer II 3 Parallel 1 Serial I/O Card.
5. CP/M*-80 2.2.
6. All documentation and manuals.

It all adds up to $2712.00

TOTAL PACKAGE PRICE

$1950.00

YOU SAVE $762.00!

ORDER PART NO. GBT-SPEC-C
Big 8 System with Interfacer I
ORDER PART NO. GBT SPEC-D
Big 8 System with Interfacer II

SAVE EVEN MORE, when you add 2 Shugart 801R disk drives, and a dual Vista Cabinet with Power Supply.

This package adds up to $4062

TOTAL PACKAGE PRICE

$3095.00

YOU SAVE $967.00

GBT-SPEC-EV with Interfacer I
GBT-SPEC-FV with Interfacer II

Ciarcia's Circuit Cellar

Micromouth for use on Apple II or other parallel ports A&T Featured in June BYTE

MMMI-94VOAPL $149.00

Micromouth for use of TRS-80 Model 1 complete with cable, AC Adapter, less enclosure A&T.

MMI 94VOTRSI $169.00

Expansion Interface for TRS-80 Model 1 with DATA SEPARATOR. 32K of RAM, and Centronics Printer port. A&T. Featured in MARCH BYTE.

MMI-DISK80 $429.00

16 BIT

A second chance, we offered a limited number of these "BIG 16" packages 2 months ago and quickly sold out, leaving many customers disappointed. We had so many customers who wanted to get a second system, and many more who just wanted a chance to get one system, that we went back to GODBOUT, and convinced them to make another production run just for us. (They can't ignore our requests when we purchase boards by the 1,000's.) Here is your second chance to step up to the World of 16 Bit Computers and save hundreds, even thousands, of dollars if you act right now.

Here's what you get

1. 16 bit/8 bit Dual Processor (w/6 MHz 8088)
2. System Support 1 with Serial I/O. Real time clock, Interval Timers & More!
3. Disk 1 DMA Floppy Disk Controller (w/BIOS for CP/M *2.2)
4. 64K of fast static RAM (w/IEEE 24 bit extended addressing)
5. Sorcim's powerful PASCAL/M* - 8086 software on disk
7. I/O and Disk Controller cables, plus full documentation on all hardware and software

*PASCAL M is a trademark of Sorcim: CP/M is a registered trademark of Digital Research

It all adds up to $3430.00

A) TOTAL PACKAGE PRICE

$2495.00

YOU SAVE $935.00

ORDER PART NO. GBT SPEC-A

SAVE EVEN MORE, when you add 2 Shugart 801R disk drives, and a dual Vista Cabinet with Power Supply.

This package adds up to $4780.

B) TOTAL PACKAGE PRICE

$3650.00

YOU SAVE $1130.00

ORDER PART NO. GBT-SPEC-BV

Ciarcia's Circuit Cellar

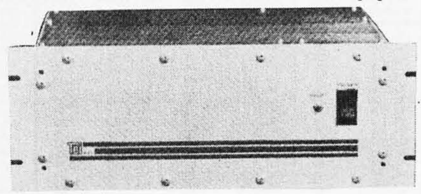
I/O Interface for TRS-80. Features 50-19200 baud RS-232C Serial port and Centronics printer port. Connect up to 16 COMM-80's to either Keyboard or Expansion Interface. Featured in June 80 BYTE.

MMI-COMM-80 $179.95

TEI MicroFrame®

From the power supply through the sturdy chassis, TEI constructs and assembles each mainframe with great care. Every TEI mainframe utilizes a constant voltage transformer (CVT) which delivers clean, regulated power at the proper level, reducing the heat in the computer cards. The output voltage on the transformer remains nearly even with the input voltage varyng from approximately 85V to 140V. This means the mainframe will never notice voltage variations or even a brownout. It lso provides 100 dB noise rejection to protect the computer from voltage spikes and line noise.

No need for a dedicated line or expensive noise filters. TEI was the first manufacturer to offer the CVT in its complete computer product line and is still one of few manufacturers to offer the CVT as standard equipment.



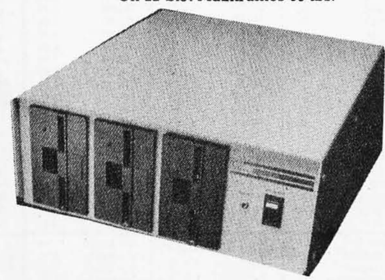
TEI 22 slot and 12 slot mainframes offer a S-100 motherboard which is grounded, shielded and actively terminated for high speed operation now or for later upgrading. Each mainframe is shipped completely assembled, tested and burned in, with fan, washable filter, all connectors and card guides. Rackmount models are available in both 22 and 12 slot mainframes. The combination of the lowest noise bus, a regulated CVT power system and a rugged chassis produces a mainframe without equal.

S-100 MAINFRAMES		LIST PRICE	OUR PRICE
TEI-MCS 112	12 Slot Desk	$685.00	$615.00
TEI-MCS 122	22 Slot Desk	$845.00	$760.00
TEI-RM 12	12 Slot Rackmount	$800.00	$720.00
TEI-RM 22	22 Slot Rackmount	$945.00	$850.00

Shipping Weight: On 12 Slot Mainframes 35 lbs.
On 22 Slot Mainframes 50 lbs.

12 slot; +8V @ 17A, ±16V @ 2A; 35 lbs.
22 slot; +8V @ 30A, ±16V @ 4A; 50 lbs.

Shipping Weight: On 12 Slot Mainframes 40 lbs.
On 22 Slot Mainframes 55 lbs.



S-100 MAINFRAME WITH 12 SLOT MOTHERBOARD AND CUTOUTS FOR 3 5¼" FLOPPY DISK DRIVES
WITH INTERNAL POWER CABLES

		LIST PRICE	OUR PRICE
TEI-TF12	12 slot desk	695.00	625.00
TEI-RF12	12 slot rackmount	795.00	715.00

DUAL 8" DISK DRIVE CHASSIS

For Shugart 800/801R with internal power cables provided		LIST PRICE	OUR PRICE
TEI-DFDO	Desk Top	669.00	599.00
TEI-RFDO	Rack Mount	819.00	749.00

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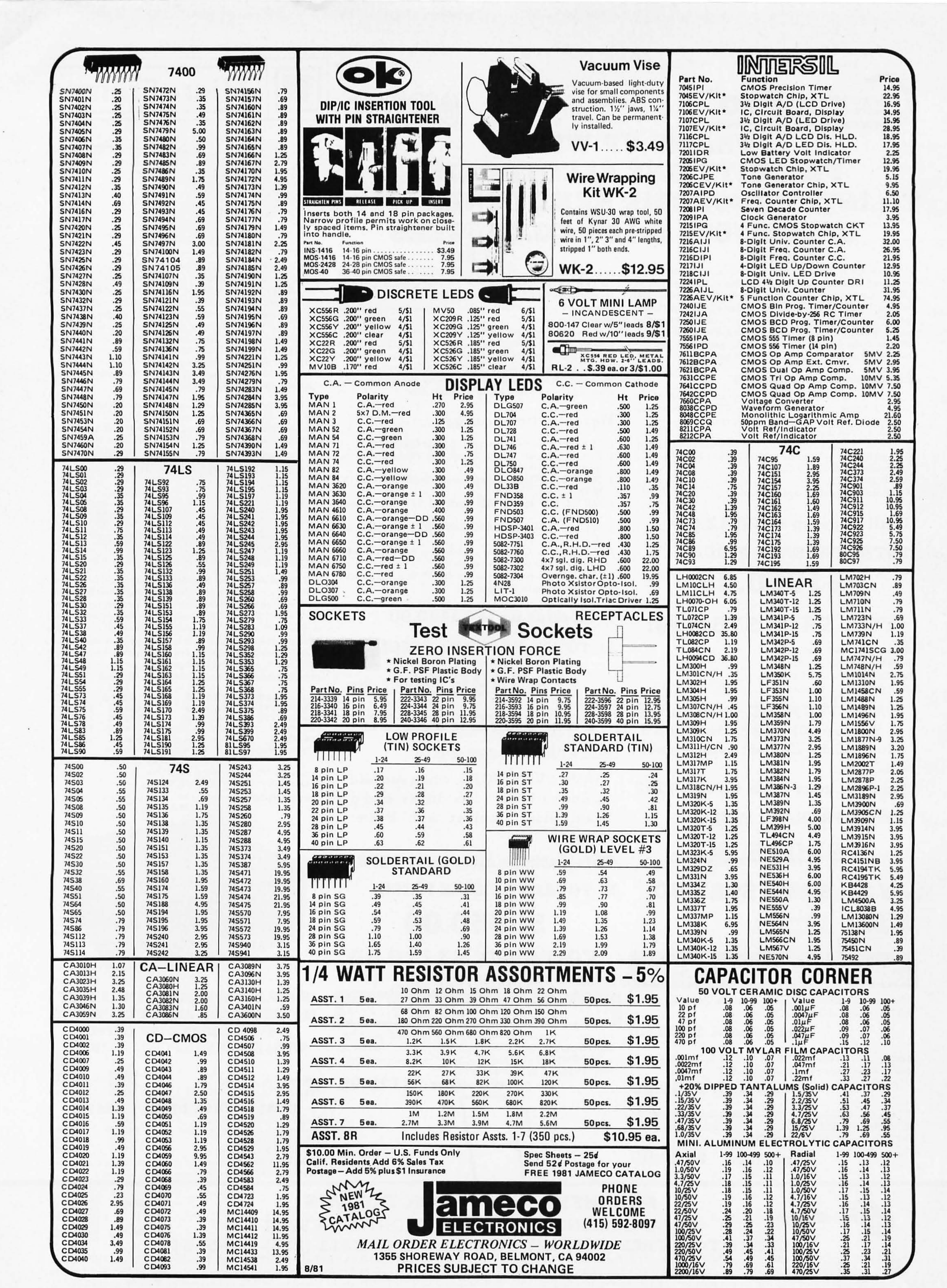


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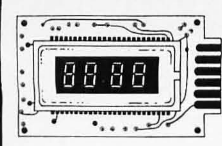
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Circle 316 on inquiry card.



Circle 183 on inquiry card.

National Semiconductor Clock Modules



12VDC AUTOMOTIVE/ INSTRUMENT CLOCK

APPLICATIONS:
- In-dash autoclocks
- After-market auto/ RV clocks
- Aircraft-marine clks.
- 12VDC oper. instru.
- Portable/battery powered instrumnts.

Features: Bright 0.3" green display. Internal crystal time-base. ± 0.5 sec./day accur. Auto. display brightness control logic. Display color filterable to blue, blue-green, green & yellow. Complete—just add switches and lens.

MA1003 Module $16.95

CLOCK MODULES

MA1023	.7" Low Cost Digital LED Clock Module	8.95
MA1026	.7" Dig. LED Alarm Clock/Thermometer	18.95
MA5036	.3" Low Cost Digital LED Clock/Timer	6.95
MA1002	.5" LED Display Dig. Clock & Xformer	9.95

TRANSFORMERS

102-P20	Xformer for MA1023 Clock Modules	3.49
102-P22	Xformer for MA1026 Clock Modules	3.49
102-P20	Xformer for MA5036 Clock Modules	3.49

8 OHM SPEAKER

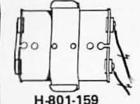


A0201

2¼" — 8 Ohm — .25 watt

$1.25 ea. 2/$1.95 ea. 10/$7.95 ea.

BATTERY HOLDER

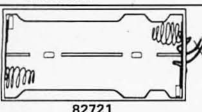


H-801-159

- Holds 2 ea. C cells
- Aluminum Case
- 5" leads

$ .45 each 10/$3.95

BATTERY HOLDER

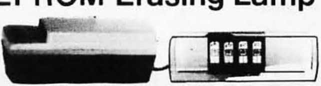


82721

- Holds 4 ea. C cells
- Plastic case
- 9" leads

$ .49 ea. 10/$4.25

EPROM Erasing Lamp

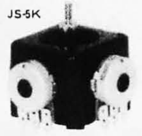


- Erases 2708, 2716, 1702A, 5203Q, 5204Q, etc.
- Erases up to 4 chips within 20 minutes.
- Maintains constant exposure distance of one inch.
- Special conductive foam liner eliminates static build-up.
- Built-in safety lock to prevent UV exposure.
- Compact — only 7-5/8" x 2-7/8" x 2"
- Complete with holding tray for 4 chips.

UVS-11E........... $79.95

JOYSTICKS

JS-5K





JVC-40

JS-5K	5K Linear Taper Pots	$5.25
JS-100K	100K Linear Taper Pots	$4.95
JVC-40	40K (2) Video Controller in case	$5.95

6-Digit Clock Kit



- Bright .300 ht. comm. cathode display
- Uses MM5314 clock chip
- Switches for hours, minutes and hold modes
- Hrs. easily viewable to 20 ft.
- Simulated walnut case
- 115 VAC operation
- 12 or 24 hr. operation
- Incl. all components, case & wall transformer
- Size: 6¾" x 3-1/8" x 1¾"

JE701.............. $19.95

NEW! JE215 Adjustable Dual Power Supply

General Description: The JE215 is a Dual Power Supply with independent adjustable positive and negative output voltages. A separate adjustment for each of the supplies provides the user unlimited applications for IC current voltage requirements. The supply can also be used as a general all-purpose variable power supply.

FEATURES:
- Adjustable regulated power supplies, pos. and neg. 1.2VDC to 15VDC.
- Power Output (each supply): 5VDC @ 500mA, 10VDC @ 750mA, 12VDC @ 500mA, and 15VDC @ 175mA.
- Two, 3-terminal adj. IC regulators with thermal overload protection.
- Heat sink regulator cooling
- LED "on" indicator
- Printed Board Construction
- 120VAC input
- Size: 3-1/2"w x 5-1/16"L x 2"H

JE215 Adj. Dual Power Supply Kit (as shown) . . $24.95

(Picture not shown but similar in construction to above)

JE200 Reg. Power Supply Kit (5VDC, 1 amp) . .	$14.95
JE205 Adapter Brd. (to JE200) ±5,±9 & ±12V.	$12.95
JE210 Var. Pwr. Sply. Kit, 5-15VDC, to 1.5amp.	$19.95

MICROPROCESSOR COMPONENTS

8080A/8080A SUPPORT DEVICES

INS8080A	CPU	6.50
DP8212	8-Bit Input/Output	3.25
DP8214	Priority Interrupt Control	5.95
DP8216	Bi-Directional Bus Driver	3.49
DP8224	Clock Generator/Driver	3.95
DP8226	Bus Driver	3.49
DP8228	System Controller/Bus Driver	4.95
DP8238	System Controller	5.95
INS8243	I/O Expander for 48 Series	9.95
INS8250	Asynchronous Comm. Element	16.95
DP8251	Prog. Comm. I/O (USART)	7.95
DP8253	Prog. Interval Timer	14.95
DP8255	Prog. Peripheral I/O (PPI)	9.95
DP8257	Prog. DMA Control	19.95
DP8259	Prog. Interrupt Control	14.95
DP8275	Prog. CRT Controller	49.95
DP8279	Prog. Keyboard/Display Interface	19.95
DP8300	Octal Bus Receiver	6.95
DP8303	System Timing Element	6.95
DP8304	8-Bit Bi-Directional Receiver	3.95
DP8307	8-Bit Bi-Directional Receiver	3.95
DP8308	8-Bit Bi-Directional Receiver	3.95

6800/6800 SUPPORT DEVICES

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MC6802CP	MPU with Clock and RAM	19.95
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MC6821	Peripheral Inter. Adapt (MC6820)	7.49
MC6828	Priority Interrupt Controller	10.95
MC6830L8	1024x8-Bit ROM (MC68A30-8)	14.95
MC6850	Asynchronous Comm. Adapter	6.95
MC6852	Synchronous Serial Data Adapter	6.95
MC6860	0-600bps Digital MODEM	10.95
MC6862	2400bps Modulator	12.95
MC6880A	Quad 3-State Bus. Trans. (MC8T26)	2.25

MICROPROCESSOR CHIPS

Z80 (780C)	CPU (MK3880N) (2MHz)	13.95
Z80A (780-1)	CPU (MK3880N-4) (4MHz)	15.95
CDP1802	CPU	19.95
2650	MPU	16.95
IDM2901ADC	CPU—4-Bit Slice (Com. Temp. Grade)	19.95
MCS6502	MPU w/Clock (65K Bytes Memory)	11.95
INS8035N-6	MPU—8-Bit (6MHz)	16.95
INS8039N-6	CPU—Sgl. Chip 8-Bit (128bytes RAM)	19.95
INS8040N-6	CPU (256 Bytes RAM)	24.95
INS8070N	CPU—64 Bytes RAM	24.95
INS8073N	CPU w/Basic Micro Interpreter	29.95
P8085	CPU	19.95
INS8900	CPU—16-Bit	29.95
TMS9900JL	MPU—16-Bit	49.95

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MM500H	Dual 25-Bit Dynamic	.50
MM503H	Dual 50-Bit Dynamic	.50
MM506H	Dual 100-Bit Static	.50
MM510H	Dual 64-Bit Accumulator	.50
MM1402	256-Bit Dynamic	3.95
MM5013	1024-Bit Dynamic/Accumulator	1.95
MM5016H	500/512-Bit Dynamic	.89
MM5034N	Octal 80-Bit	9.95
MM5035N	Octal 80-Bit	9.95
2504V (1404A)	1024-Bit Dynamic	3.95
2518N	Hex 32-Bit Static	4.95
2522V	Dual 132-Bit Static	2.95
2524V	512-Bit Dynamic	.99
2525V	1024-Bit Dynamic	2.95
2527V	Dual 256-Bit Static	2.95
2528V	Dual 250-Bit Static	4.00
2529V	Dual 240-Bit Static	4.00
2532N	Quad 80-Bit Static	2.95
3341PC	Fifo (Dual 80)	6.95

DATA ACQUISITION

AF100-1CN	Universal Active Filter 2.5%	5.95
AF121-1CJ	Touch Tone Low Pass Filter	19.95
AF122-1CJ	Touch Tone Low Pass Filter	19.95
LM308AH	Super Gain Op Amp	1.00
LM334Z	Constant Current Source	1.30
LM335Z	Temperature Transducer	1.40
LF356N	JFET Input Op Amp	1.10
LF398N	Sample & Hold Amplifiers	3.95
LM399H	Temp. Comp. Prec. Ref. (.5ppm/C°)	4.95
ADC0804LCN	8-Bit A/D Converter (1 LSB)	4.95
DAC0806LCN	8-Bit D/A Converter (0.78% Lin.)	2.25

DATA ACQUISITION (CONTINUED)

ADC0809CCN	8-Bit A/D Converter (8-Ch. Multi.)	5.25
ADC0817CCN	8-Bit A/D Converter (16-Ch. Multi.)	10.95
DAC1000LCN	10-Bit D/A Conv. Micro. Comp. (0.05%)	13.95
DAC1008LCN	10-Bit D/A Conv. Micro. Comp. (0.20%)	8.95
DAC1020LCN	10-Bit D/A Converter (0.05% Lin.)	8.49
DAC1022LCN	10-Bit D/A Converter (0.20% Lin.)	5.95
DAC1222LCN	12-Bit D/A Converter (0.20% Lin.)	9.95
CD4051N	8-Channel Multiplexer	1.19
AY-5-1013	30K BAUD UART	5.95

RAM'S

1101	256x1 Static	1.49
1103	1024x1 Dynamic	.99
2101 (8101)	256x4 Static	3.95
2102	1024x1 Static	1.75
21L02	1024x1 Static	1.95
2111 (8111)	256x4 Static	3.95
2112	256x4 Static MOS	4.95
2114	1024x4 Static 450ns	5.95
2114L	1024x4 Static 450ns Low Power	6.95
2114-3	1024x4 Static 300ns	7.49
2114L-3	1024x4 Static 300ns Low Power	7.95
2117	16,384x1 Dynamic 550ns (house marked)	4.95
4116N-4 (UPD416)	16K Dynamic 250ns (MM5290N-4)	3.95
4164	64K Dynamic 250ns	49.95
MM2147J	4096x1 Fast 70ns	19.95
5101	256x4 Static	7.95
MM5261	1024x1 Dynamic Fully Decoded	.99
MM5262	2Kx1 Dynamic	.25
MM5280/2107	4096x1 Dynamic	4.95
MM5290N-2 (4116)	16K Dynamic 150ns (UPD416C-3)	5.25
MM5298J-3A	8K Dyn. 200ns (lower ½ of MM5290J)	4.95
MM5799NAA/N	Controller Oriented Processor	9.95
UPD414/MK4027	4K Dynamic 16-pin	4.95
TMS4044-45NL	4K Static	14.95
TMS4045	1024x4 Static	14.95

PROMS/EPROMS

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2708	8K EPROM	5.95
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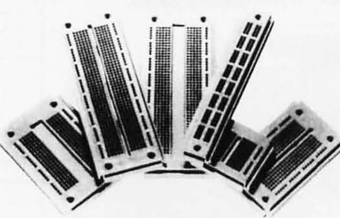
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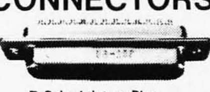
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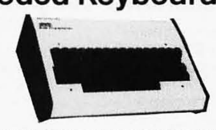
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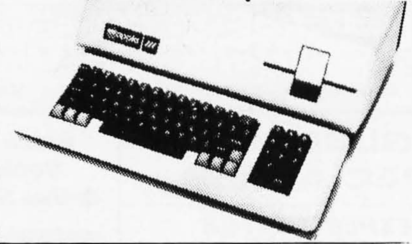
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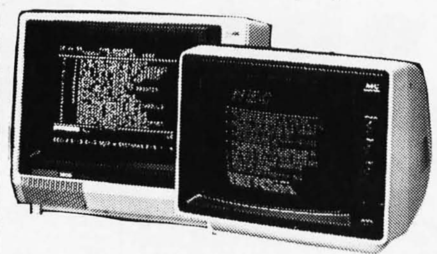
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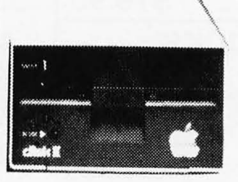
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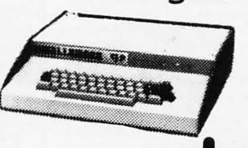
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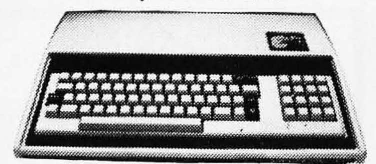
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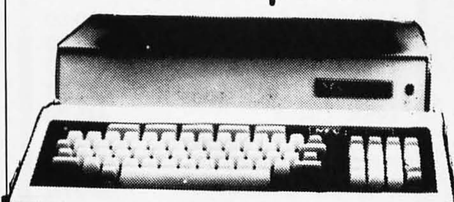
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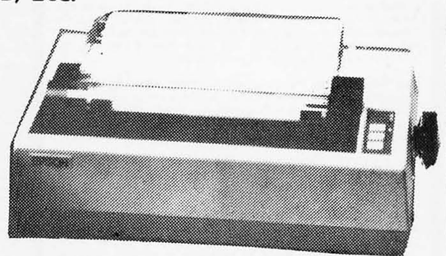
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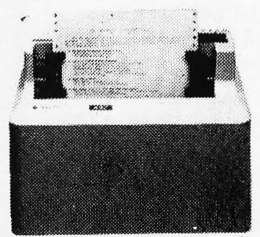
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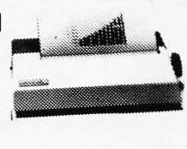
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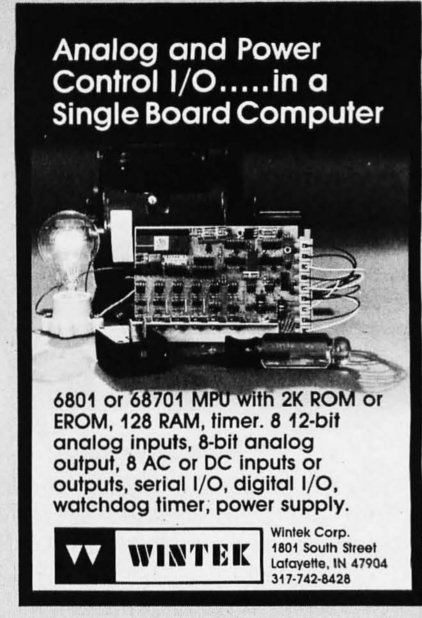
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RAM 17 48K	786.	DISK SYSTEM	Call
Enclosure 2 Desk	619.	Enclosure 2 Rack	671.
TELEVIDEO 910 NEW	600.	Televideo 920C	725.
Televideo 950	975.	Ampex Dialogue 80	975.
C.ITOH 25CPS. SW	1495.	NEC 5510 SW	2795.
EPSON MX80 par	473.	MX80 FT par	645.

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SBC 2/4 MHz Z80A	265.	Expandable+II 64K	599.
RAM 16 16K 4MHz	195.	RAM 65 16K Bank	210.

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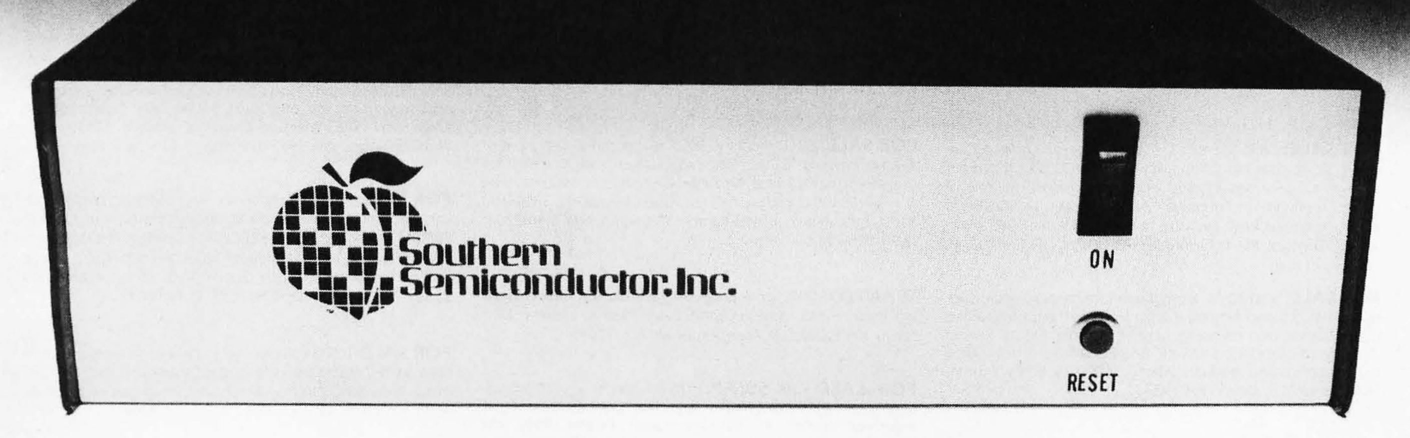
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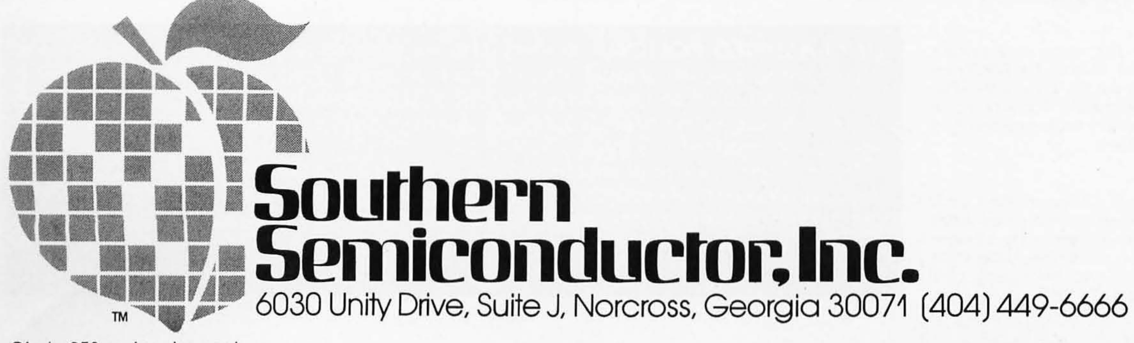
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Remember the last time you waited for your printer to complete a printout so you could get down to business with your computer? Well now you can untie your computer with Southern Semiconductor's "Fast Spooler". Large blocks of data can be transmitted at high speed to the "Fast Spooler" so your computer is available for more important functions. Long printouts can be handled entirely by the spooler — a real timesaver for word and data processing.

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Unclassified Ads

FOR SALE: IMSAI 8080; $560. Tarbell interface with two PerSci 70 8-inch disk drives, case, and power supply; $1400. VDM-1; $190. 16 K static programmable memory; $180. IMSAI MIO; $100. Selectric I/O; $650. BYTE, Kilobaud Microcomputing, and Interface Age; write for details. T Tai, 115 Bonny Ln, Collegeville PA 19426.

FOR SALE: Digital Group Z80 dual Phi-Deck system with 34 K memory. Godbout memory board can be expanded from 16 K to 32 K. The system has a 64 by 16 display, BB-cab, and Phi-cab. A Sanyo 9-inch monitor and two keyboards are part of the package. A large amount of software is also included (Phimon, Hi-Phi, Business BASIC, Sargon, Super Games, etc). $1250. D Reavis, 4355 Morris St, Salt Lake City UT 84119, (801) 966-0065.

FOR SALE: 9-inch video monitors. No case, in factory carton. 100% prime tested, but never used. Green-phosphor display, requires composite video and 13 thru 16 VDC inputs. Schematic included. I can ship COD, but I will pay shipping if you send a money order for $60. Chris Kalmbach, 422 S Florida Ave, Joplin MO 64801.

FOR TRADE OR SALE: BYTE: Vol. 6, #4-1, Vol. 5, #12-3, Vol. 4, #8, Vol. 3, #11, 4. Walter Jeffries, RFD 1, Readfield ME 04355.

WANTED: Apple II with 16 K. Must be in good to excellent condition. Marc Lenburg, 14 Meadowbrook Dr, Hadley MA 01035.

FOR SALE: Ohio Scientific C4P small-business computer. Includes 52 K, dual 8-inch floppy drives with 600,000 K bytes of storage, OS-65D and OS-65U operating systems, full line of related manuals, and monitor. All for $2500. UCSD Pascal development package available at $300 (includes FORTRAN). John F Dutcher, RD 1, Oxford NY 13830, (607) 843-9206.

FOR SALE: SOL-20/16 K programmable memory microcomputer, 9-inch Sanyo monitor, Diablo Hy-Type tractor-feed letter-quality printer with keyboard, cassette recorder, Electric Pencil I and II word-processing software, BASIC/5 software, debugging tape, supplies, and manuals. Asking $4000. Pete Pennington, 580 Gregory Ln, Devon PA 19333.

FOR SALE: Wave-Mate 6800 64 K computer, dual 8-inch floppy-disk drives, and Infoton 80-column video display. Includes software: Dynamics editor, assembler, and BASIC compiler. Asking $3000 or best offer. Will consider selling separately. Scott Joslyn, 5411 El Jardin St, Long Beach CA 90815, (213) 597-1749.

FOR SALE: Seales 8 K memory board for SS-50 bus; $100. SwTPC MP-A processor board less ICs; $20. Conrac 21-inch black-and-white monitor; $25 (pick-up locally only). Joe Dubner, 865 S Haskett St, Mountain Home ID 83647, (208) 587-9383.

FOR SALE: Diablo Hy-Type I/Hy-Type II or IBM Selectric printer interface. The input is Centronics-compatible (parallel). The unit is stand alone and has a 16 K FIFO print buffer. Ted Warn, POB 526, Knightdale NC 27545, (919) 266-9411.

FOR SALE: Quest Super ELF 1802 system in cabinet, 4 K expansion board, monitor and Tiny BASIC read-only memory, power supply, RF modulator, ASCII keyboard, manuals, magazines, and tapes. $300. Richard Moffie, 20121 Leadwell St #3, Canoga Park CA 91306, (213) 341-6098.

HELP: I have an INFO 2000 with TDL monitor and piggyback intelligent controller to PerSci drives. I lost the first EPROM on the S-100 board. Need DUMP or will buy copy of the chip. Company no longer has the information. If anyone has a similar system, please write or call collect. Edgar Alberding, POB 382, Salem IN 47167, (812) 883-2644.

FOR SALE: Cromemco Z2 chassis, Cromemco ZPU, Central Data 64 K twin-port SIO programmable-memory card, IMSAI twin-port SIO, Morrow second disk controller, and two Shugart 801 floppy drives. The above is up and running under CP/M 1.4 with a Hazeltine 1500 terminal. $4200. Rick Pugsley, 1911 W Callender, Peoria IL 61604, (309) 674-4343.

FOR SALE: Nine female Pin D connectors; $1.50 each. Retaining clips and mounting screws; $0.50/set of two each. Strain-relief cases for 15-pin D connectors; $3 each. 30-pin card-edge connectors, solder-eye, 0.156-inch spaces, gold-plated, bifurcated contacts; $2.50 each. Limited quantity, first come, first served. 10% for shipping and handling. Money order or cashier's check only. Kurt A Schultz, 115-1 Roxanne Ct, Walnut Creek CA 94596.

FOR SALE: Complete set of BYTE. Make offer on any or all issues. John Cowan, 613 Navarra Dr, Scotts Valley CA 95066, (408) 438-5116.

WANTED: Our nonprofit college radio station desperately needs the donation of a video terminal or Teletype. Working or nonworking is okay. We need the terminal fairly soon to secure an I/O port on the new college computer. Your donation is fully tax deductible and will be acknowledged by a Swarthmore College receipt. Steve Podell, WSRN-FM, Swarthmore College, Swarthmore PA 19081, (215) 447-7340. May thru August: 90 Terrace Ln, Moss Beach CA 94038, (415) 728-3248.

FOR SALE: Printer: 165 cps, excellent condition, variable character size, double-width characters, graphics can be added, same mechanism as the IDS printers. Best offer. S Levine, 1802 Melville St, Ocean NJ 07712, (201) 531-8305 after 6 PM.

FOR SALE: Apple Silentype printer. As new and complete. $450. Al Coombe, 807 Neal Dr, Gurley AL 35748, (205) 776-2378 after 6 CT.

FOR SALE: S-100 memory: SDS Expandoram II with 32 K of 4 MHz memory. Bank select, expandable to 64 K. Certificate of performance by Jade. Novation CAT acoustic modem, nearly new, RS-232C compatible. Guaranteed working. $350 and $150. Nick Reiber, 11458 Benton St, Loma Linda CA 92354, (714) 825-7942.

WANTED: Daily stock prices on Pet cassettes. One cassette per issue. Hi, lo, close, volume, date. 1960 to present. Don Nyre, 305 LaJolla Dr, Newport Beach CA 92663.

FOR SALE OR SWAP: TRS-80 Model I with upper-case/lowercase modification in keyboard. Complete with 48 K expansion interface, RS-232C and modem, Percom drives, and Centronics 730 printer. Only one year old; selling to do major hardware upgrade. Software: NEWDOS/80, Miller-FORTH and Datahandler, Pascal, FORTRAN, VisiCalc, Disk Ed/Asm, Stockpak, Scripsit, etc. $5000 investment. Want S-100 or STD bus Z80 equipment with 8-inch drives. Alan Wilcox, POB 151, Archbald PA 18403, (717) 586-8515 before 9 PM.

FOR SALE: Televideo 920C terminal with second-page memory option. Used for only three months and in mint condition in its original shipping container. Will send UPS postage paid to the first person submitting a $700 certified check or money order. G D Kaplan, POB 1462, Laguna Beach CA 92652, (714) 499-2724.

WANTED: Poor student in need of any and all S-100 (preferred) computer boards, peripherals, software, and electronic components. Need not work. Send list of equipment and price. Jonathan A Chandross, 14 Hunterdon Blvd, Murray Hill NJ 07974.

FOR SALE: Brand-new unused Apple communication card. Best offer. R J Crafts, POB 262, Ocean Heights, Edgartown MA 02539, (617) 627-4707 days, 627-8867 evenings.

FOR SALE: Digital Group computer. Factory wired, less than five hours running time. Z80A processor, 32 K static programmable memory, keyboard, and dual Phi-Deck (early board). Complete documentation, showroom condition. $700 or best offer, FOB Los Angeles. J Zubrecky, 328-A Russell Ave, Monterey Park CA 91754, (213) 571-1554.

FOR SALE: Heath H-89 all-in-one microcomputer. Less than ten hours use, looks and works perfect. Single floppy-disk drive, 48 K programmable memory, cassette interface, cassette player, HDOS 2.0 disk operating system, and Extended Benton Harbor and Microsoft BASIC. Full documentation plus miscellaneous software. $3000 value for $2000. Will ship anywhere. Thomas F Arnold, 6961 Island Rd, Clay NY 13041, (315) 699-5310.

FOR SALE: IMSAI MIO board and Processor Technology 3P + S board. Assembled and tested with all IC sockets and guaranteed working. MIO contains one serial port, two parallel ports, and a Tarbell cassette interface for S-100 bus systems. 3P + S contains three parallel ports and one serial port for S-100 bus systems. $100 each plus shipping. Will ship COD. John Dunning, 1395 Main St, Waltham MA 02154, (617) 899-7244 days only.

FOR SALE: Heath H-11: 32 K, two serial and one parallel boards, two extra LSI-11/2 processor modules, extended arithmetic chip, WH-27 factory-assembled floppy disk, DEC VT100 video terminal, DEC LA36 DECwriter II Accelwriter (600 bps) equipped, Heath computer desk, super software package, all accessories, many extras, running and ready to go. Will accept any bona fide offer over $5000. Will separate. Greg Krzyzowski, 5223 Main St, Downers Grove IL 60515, (312) 963-0250 days, 964-4429 evenings.

FOR SALE: Apple II peripherals: Hayes Microcomputer Products micromodem and Videx 80-column board. Free interface EPROM for modem; spare EPROMs and programmer for video board. Also, Mountain Hardware clock. Everything 1/3 off current price or trade for Apple Graphic Pad. James Leatham, RD 2, Box 198, Chester NY 10918, (914) 469-4092.

FOR SALE: BYTE, complete set to present, in excellent condition. SwTPC 6800 complete system, cassette-based with terminal. New RS/Centronics 779 in unopened box. Make offers. John French, 8045 Alida St, La Mesa CA 92041.

WANTED: Bare printed-circuit board for D C Hayes 8-103A modem. D Reinebeck, 899 Fairfield Rd, North Vancouver British Columbia, V7H 2J4 Canada, (604) 929-5759.

FOR SALE: Assembled and working Heathkit H-8 with 8 K memory, H-8-5 serial interface board, Extended BASIC and regular BASIC tapes, tape recorder, and manuals. $350 or best offer. Micro-Term serial keyboard; $350. Sanyo 9-inch monitor; $125. RF modulator (used with Apple computer); $20. Bill Lofton, 5840 Sun Valley Way, Sacramento CA 95823, (916) 393-0154.

FOR TRADE: A Leslie Model 145 organ amplifier/speaker and preamplifier for a computer of comparable value. Like-new condition. I will deliver within a 250-mile radius. Marlin Meier, 801-J Patterson Rd, Dayton OH 45419, (513) 299-7156.

FOR SALE: APF Imagination Machine. Only two months old. Excellent condition. Paid $599, will sell for $450 or offer. Also, interested in buying used Apple II with 48 K. Steve Grabarczyk, 4921 W Midland Dr, Greenfield WI 53219, (414) 543-7989.

UNCLASSIFIED POLICY: Readers who are soliciting or giving advice, or who have equipment to buy, sell or swap should send in a clearly typed notice to that effect. To be considered for publication, an advertisement must be clearly noncommercial, typed double spaced on plain white paper, contain 75 words or less, and include complete name and address information.

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BYTE's Ongoing Monitor Box

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May BOMB Results: Printers Top List

By one of the largest margins in BOMB's history, Kevin Cohan's article "The Epson MX-80 and MX-70 Printers" swept first place in the May contest. The $100 first prize will be donated to charity in Kevin's name. (Kevin Cohan, a technical editor at BYTE, was killed in an automobile accident April 22.)

Steve Ciarcia's "DC Motor Controls: Build a Motorized Platform" captured second place and the $50 prize. Third place went to senior editor Gregg Williams for his article "The Commodore VIC 20 Microcomputer: A Low-Cost, High-Performance Consumer Computer," and fourth place went to technical editor Stan Miastkowski for his article "Extended Color BASIC for the TRS-80 Color Computer."

POPULAR BASIC LISTINGS

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☐ LAS VEGAS BINGO PINBALL (game card simulation) $ 5
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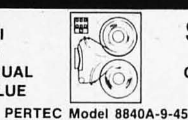
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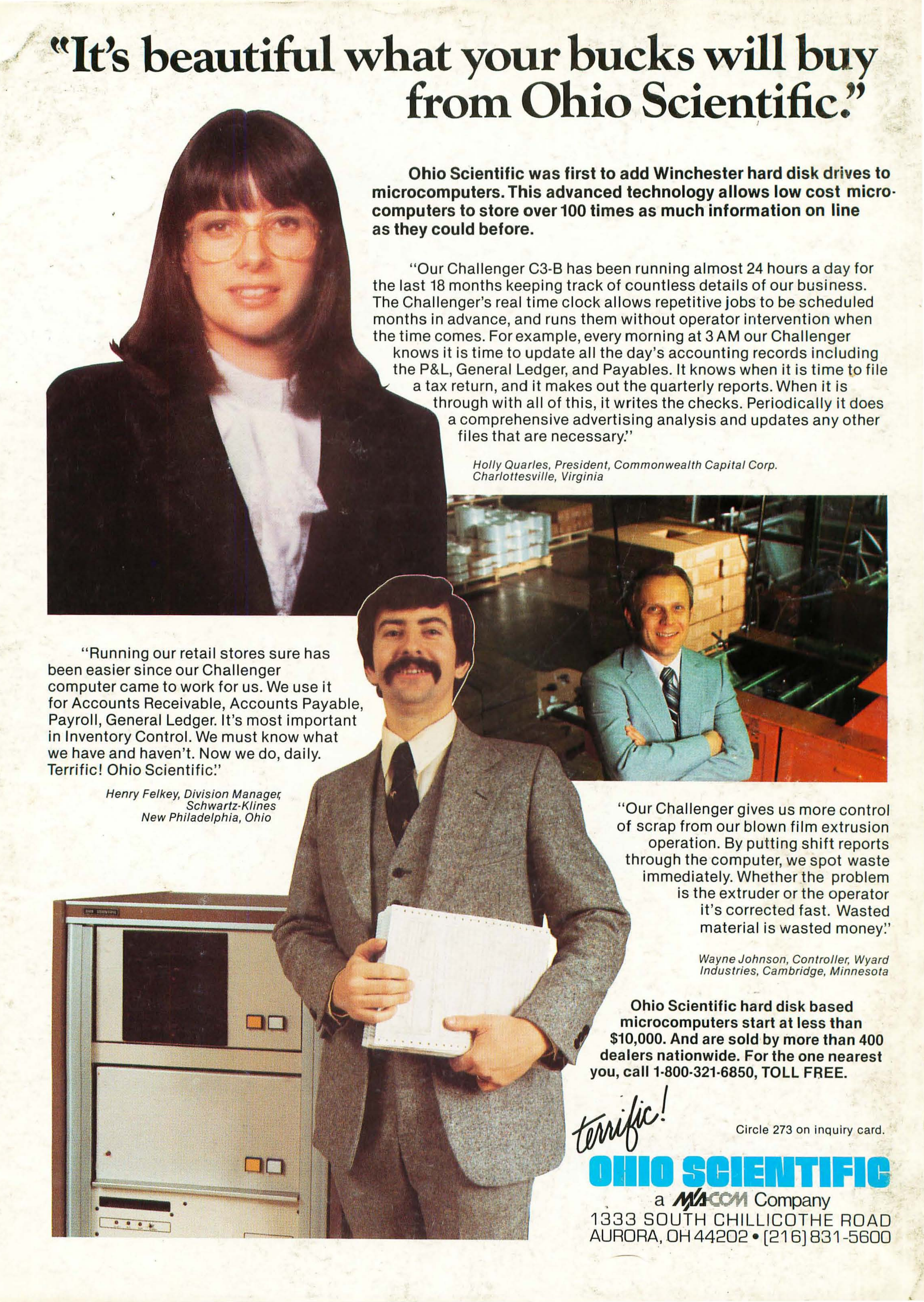
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